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THE IN-HOUSE MANAGEMENT APPROACH:
AN ANALYSIS OF THE
SUBSONIC CRUISE ARMED DECOY PROGRAM,

THESIS

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The purpose of this report is to examine the management approach utilized by the Subsonic Cruise Armed Decoy (SCAD) Program Office. The reason for such a study is to aid future program managers in adopting their management arrangements.

System integration and who accomplishes it is the key to the in-house approach. System integration is performed whenever system engineering is applied

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The SCAD program began in 1968 and ran until July 1973 when its full scale development was terminated. The program office contracted for, managed the development of, and was responsible for the integration of all major subsystems. Multiple contracts were used and an associate contractor arrangement employed. Many innovative management techniques were utilized and several strengths were observed during SCAD's development. Chief among the strengths were the more direct involvement of Air Force personnel in the decision making process and the associated visibility into problem areas. The primary weaknesses of the approach included the lack of qualified personnel to do the integration task and the adoption of a program office organizational structure which was not conducive to system integration.

It is concluded that the in-house approach to weapon system acquisition does have merit and should be considered as a viable program management option. For the approach to be effectively used the program office must be adequately staffed with qualified people and organized in such a way as to promote total system integration.

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THE IN-HOUSE MANAGEMENT APPROACH:
AN ANALYSIS OF THE
SUBSONIC CRUISE ARMED DECOY PROGRAM

THESIS

Presented to the Faculty of the School of Engineering

of the Air Force Institute of Technology

Air University

in Partial Fulfillment of the

Requirements for the Degree of

Master of Science

by

Robert W. Buckner, B.S.

Captain USAF

Graduate Systems Management

September 1974

Preface

In an attempt to manage complex weapon system acquisition programs within cost, schedule, and performance parameters the Air Force has applied various management approaches and organizational arrangements. One of the most unique concepts attempted was exemplified by the Subsonic Cruise Armed Decoy (SCAD) Program Office, wherein maximum use of in-house management and development resources was applied. The SCAD Program Office performed system engineering and integration functions in lieu of a system or prime contractor. This approach came to be known as the "in-house management approach."

The intent of this thesis is to provide a description and analysis of the in-house approach as utilized in the SCAD program. It is hoped that this report will provide systems managers some information about an approach to be considered when establishing future programs.

The idea of studying some aspect of the SCAD program came from my association with the program from August 1971 through May 1973.

Encouragement and information were offered by Lt Col Jerry V. Poncar who, while attending Air War College, studied the key program decisions made in the SCAD progrm. He was the first person to recommend an analysis of the in-house management approach. Through a series of discussions with Major Edward J. Dunne, my advisor, the topic was scoped and a research methodology proposed. Throughout the thesis effort Major Dunne provided suggestions and guidance. His questions and recommendations have made this report much more valuable than it would have been otherwise.

Special acknowledgements go to personnel in the Air Launched Cruise Missile Program Office for accepting my presence and allowing me to review

all of the SCAD documentation. Especially helpful were Mrs. Anita R. Hall and Mrs. Valaria J. Buchanan. I appreciate their patience and daily assistance.

I am also greatly indebted to all the people who took time to answer my questions and give their opinions on the subject. The insights provided through those interviews were priceless.

In conducting this research, I have gained an immeasurable education and for that opportunity I am extremely grateful.

Robert W. Buckner

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Abstract

The purpose of this report is to examine the management approach utilized by the Subsonic Cruise Armed Decoy (SCAD) Program Office. The reason for such a study is to aid future program managers in adopting their management arrangements.

System integration and who accomplishes it is the key to the in-house approach. System integration is performed whenever system engineering is applied and technical direction is given. If the Air Force program office acts as the system integrator, then the management approach is termed "in-house."

The SCAD program began in 1968 and ran until July 1973 when its full scale development was terminated. The program office contracted for, managed the development of, and was responsible for the integration of all major subsystems. Multiple contracts were used and an associate contractor arrangement employed. Many innovative management techniques were utilized and several strengths were observed during SCAD's development. Chief among the strengths were the more direct involvement of Air Force personnel in the decision making process and the associated visibility into problem areas. The primary weaknesses of the approach included the lack of qualified personnel to do the integration task and the adoption of a program office organizational structure which was not conducive to system integration.

It is concluded that the in-house approach to weapon system acquisition does have merit and should be considered as a viable program management option. For the approach to be effectively used the program office must be adequately staffed with qualified people and organized in such a way as to promote total system integration.

I. Introduction

Statement of the Problem

The evolution of the weapon system acquisition process within the Department of Defense is an example of a sincere desire to avoid past mistakes and blunt future criticisms. Over the years there has been a consistent record of close examination of the weapon system acquisition process and the problems involved. Industry councils, defense review boards, presidential commissions, and the General Accounting Office have all expressed critical views of the process and have recommended changes in the management style and organizational arrangements employed. In a report to the House of Representatives Armed Services Committee, dated 26 March 1973, the Comptroller General stated: "In an attempt to monitor weapon system acquisition programs in detail; to achieve often elusive and distant cost, schedule, and performance objectives; and to control various kinds of changes, a ponderous management organization and style has evolved over the years."

The United States Air Force has often been the leader within the Department of Defense in adjusting to changing times and conditions, and in turn utilizing innovative management techniques in an attempt to adopt an optimum management approach. In the quest for this optimum approach the roles and relationships of the Government and industry in defining and developing new systems has been an inherent issue. In recent years a realization that every program is different has led to flexibility in tailoring the management approach to the nature and character of technical activity embodied in major system acquisition programs.

Given the increased authority and responsibility necessary to mold a responsive management approach, considering program peculiarities, the program manager must use sound judgment based on experience. His experience can be drawn from personal exposure to similar circumstances, but most probably will come from knowledge of the experiences of other program managers and the management approaches which they have tried previously. Knowledge transferred by means of a detailed description of past approaches, their strengths and weaknesses, can be used in lieu of the more risky trial and error process. Much more efficient management could result from this form of "corporate memory."

Unfortunately, the methods for transferring this experience are limited. One method of providing program managers with the detailed descriptions of various management approaches already attempted is through documentation in a series of historical studies.

This thesis is an attempt to add to Air Force corporate memory by describing one acquisition program and the management approach which was taken. The program studied was the Subsonic Cruise Armed Decoy (SCAD) Program. This program is of particular interest because of the use of what can be termed the "in-house management approach." The SCAD program utilized an associate contractor arrangement, with most of the traditional prime contractor's functions performed by the program office.

Objective

The purpose of this report is to examine the management approach utilized by the SCAD Program Office. In accomplishing this primary objective, intermediate objectives are: (1) to trace the development of the SCAD program from conception to termination, (2) to describe how the approach was used, and (3) to point out strengths and weaknesses of the

approach, and (4) to draw conclusions and make recommendations. The ultimate objective of this report is to provide future program managers with useful insights concerning one approach to the process of weapon system acquisition.

Assumptions and Limitations

In order to properly scope the research which preceded this report, certain assumptions were made and limitations realized.

Assumptions

1. Management of the acquisition of weapon systems can be improved.
2. The review of previously used management approaches and experience gained in their use can aid future program managers.
3. There are lessons to be learned from the in-house management approach utilized by the SCAD Program Office.

Limitations

1. The SCAD program was terminated in July 1973 prior to completion of its full scale development phase. This study, therefore, is limited to the program's life from conception to termination - a period of approximately five years.
2. Since no controlled experiment could be performed to determine the cost of acquiring Subsonic Cruise Armed Decoys under any other management approach, there is no way to determine if there are any cost savings by using the in-house management approach.
3. Since the data contained in the thesis will include subjective information gathered from personal interviews, some bias is inevitable.

Approach

The information contained in this report comes from three sources: (1) the writer's personal association with the SCAD program through most of its full scale development, (2) an extensive research of available literature concerning system program management, and (3) interviews with key personnel associated with the SCAD program.

Personal Experience. The writer's personal experience with the SCAD program was during the period August 1971 through May 1973. He was assigned as a System Program Management Officer in the Program Control Division of the SCAD Program Office. Recognizing the potential for personal bias to enter into this report, the writer has not included personal opinion or information except where such data coincided with data from the other two sources. In all matters the writer has tried to be objective and factual.

Literature Research. A comprehensive study of pertinent literature concerning the subjects of program/project management, organizational arrangements, and system engineering and integration were conducted to provide background information for this report. Much of that information is summarized and presented as background information for the reader in Chapter 2. In addition to a study of text books, reports, theses, regulations, briefings and manuals another study effort was conducted to provide specific information on the SCAD program. All program documentation was reviewed, which included correspondence, briefings, activity reports, SCAD and ASD histories, directives and plans. The activity reports and histories provided information necessary for Chapter 3, History of the Subsonic Cruise Armed Decoy Program.

Interviews. To augment the information gained from the first two sources, a series of focused interviews was conducted with key personnel associated with the program. The purpose of the interviews was to seek out the unwritten details of how the approach worked as viewed from different positions. The participants included both military and civilian personnel who had been intimately associated with the SCAD program and a limited number of key contractor personnel. Information from their candid discussions is sprinkled throughout the report, but is concentrated in Chapter 4. An attempt to reduce the amount of individual bias from the interviews was also made. Unless an opinion or feeling was reported by more than one respondent it was not included in the report. A copy of the form used to conduct the interviews and a list of the people interviewed are included as appendices.

Organization of the Report

Prerequisite to any analysis is a clear understanding of the concepts and terminology involved. The next chapter of this report fulfills that requirement by providing definitions of basic terms and concepts plus considerable background information on various management arrangements. Chapter 2 is concluded with a simple explanation of what the writer means when he talks about an "in-house management approach." With the fundamental concepts of the second chapter as background material, Chapter 3 traces the history of the SCAD program. Chapter 4 explains the SCAD approach and how it evolved. It also includes some unique features of the program office and discusses the strengths and weaknesses of the SCAD in-house approach. The final chapter is devoted to the development of conclusions and recommendations from the findings of the research.

II. Fundamental Concepts

Before pursuing a description and analysis of the in-house management approach as it was applied on the SCAD program it is essential that the reader and writer share a common understanding of certain key terms and concepts associated with the management of weapon system acquisition. In this chapter terms are defined as they will be used throughout the remainder of this report. The system program office is defined and its typical organization discussed so that the reader will have a frame of reference or baseline to which the SCAD organization can be related. Furthermore, this chapter discusses various system management arrangements and how they have been employed over the years. Five basic Air Force/contractor arrangements are presented and the in-house approach is defined as a function of the arrangement utilized.

Basic Terms/Concepts

System. A system is a composite of equipment, skills, and techniques capable of performing and/or supporting an operational role. A complete system includes all equipment, related facilities, material, software, services, and personnel required for its operation and support to the degree that it can be considered a self-sufficient unit in its intended operational environment. (42:5)

System Engineering. The application of scientific and engineering efforts to (a) transform an operational need into a description of system performance parameters and a system configuration through the use of an iterative process of definition, synthesis, analysis, design, test and evaluation; (b) integrate related technical parameters and assure compatibility of all physical, functional and program interfaces in a manner

which optimizes the total system definition and design; and (c) integrate reliability, maintainability, safety, survivability, human and other such factors into the total engineering effort. (42:6)

Technical Direction. The act of directing by a central agency of a system development by a number of independent groups. The concept is one of a system engineering group giving broad technical direction to the program as a whole and detail direction where required to further the effort. (23)

System Integration. That which is achieved when system engineering and technical direction are accomplished. The system integrator is the organization element having the assigned system engineering and technical direction role. (23)

System/Project Management. A concept for the technical and business management of particular systems/projects based on the use of a designated, centralized management authority who is responsible for planning, directing and controlling the definition, development and production of a system/project; and for assuring that planning is accomplished by the organizations responsible for the complementary functions of logistic and maintenance support, personnel training, operational testing, activation or deployment. The centralized management authority is supported by functional organizations which are responsible to the centralized management authority for the execution of specifically assigned system/project tasks. (21:2)

System Program Office. The Air Force organizational element responsible for managing the acquisition of a weapon system is known as a system

program office. It is a formal organization whose goal is to acquire the system within cost, schedule and performance parameters. The program office is headed by a program manager, who is the responsible officer for all program management activities. He is supported by groups of specialists in the disciplines employed in program management such as engineering, procurement, logistics, training, test and finance.

The type of organizational arrangement utilized depends primarily upon the nature of the program or project - its size and complexity. Two other major factors which influence the organization structure are: (1) the phase of the life cycle the system is in, and (2) the desires of the program manager.

This last factor has not always been a major factor. During the 1960's the acquisition process was regulated by the "375" series of Air Force regulations and Air Force Systems Command supplements. These documents, "in the interest of uniformity and standardization", actually prescribed the organization structure of the program office (see Figure 1). Justification was required for any deviation from the prescribed structure. (2:7, 4:6)

In July 1971 the Air Force cancelled most of the "375" regulations and issued AFR 800-2. This regulation stresses the program manager's authority and allows him to structure the organization of the program offices to the needs of the particular program.

Typical Program Office Organization

Generally speaking, program offices are continuing to be structured in project form as depicted in Figure 1, with only minor modifications. Two possible explanations for this are: (1) without specific guidance, program managers have fallen back on what was prescribed before, or

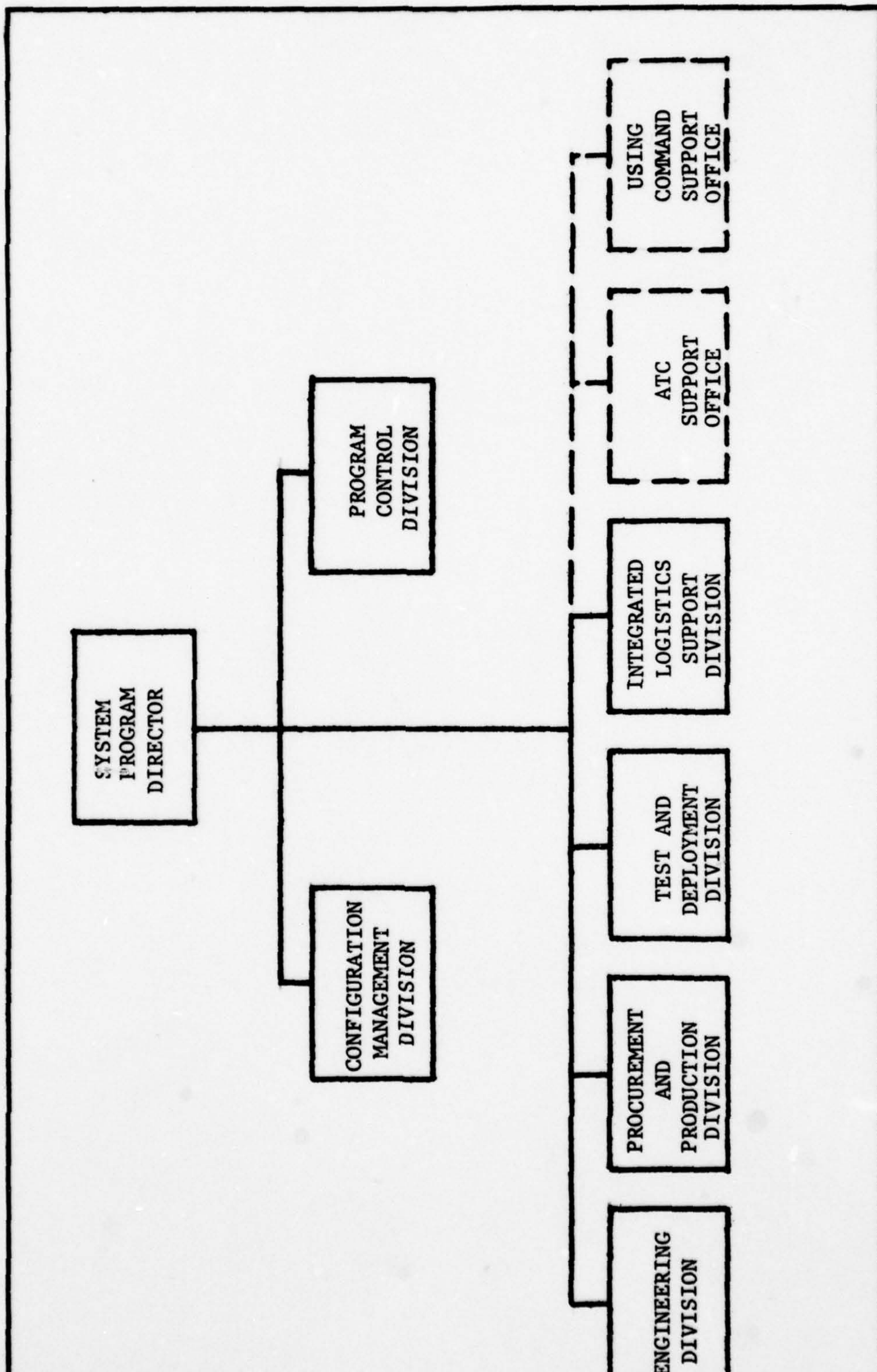

Fig. 1. Prescribed System Program Office Organization

(2) the same basic functions are still applicable. Which explanation one ascribes to is not important. What is important is an understanding of what the basic functions are. A brief description of each follows. (8:128-170)

Program Control Division. This division is responsible for planning, programming, documenting, financing, correlating and evaluating the program. Specific program control functions include cost and schedule analysis and forecasting, financial management and budgeting, program status reporting and management plans preparation.

Configuration Management Division. This division is charged with formalizing the overall system specification, controlling the hardware configuration and accounting for all the configuration items in the system. Additionally, the division manages the data management function of acquiring minimum essential contractor data.

Engineering Division. The engineers and technicians that comprise the Engineering Division in the program office perform the overall technical engineering and engineering management function of the program. They are generally involved in system analysis, design and overall technical direction of the contractor.

Procurement and Production Division. Contracting for the system is the job of this division. Basic functions include contract management, negotiation, procurement, quality assurance and production engineering and management.

Test and Deployment Division. After the system has been designed and fabricated the major subsystems and entire system must be tested. The

Test and Deployment Division is responsible for all test planning, subsystem and system testing, and flight testing. It also formulates and plans for safe deployment and checkout of the system at test and operational sites.

Integrated Logistics Support Division. This division, which is manned by both Air Force Systems Command and Air Force Logistics Command personnel, is responsible for system logistics functions and assuring the availability of logistics resources to the operational forces. They are concerned with system supportability, maintainability, and life cycle costs.

Other Participants. The program office is also supported by two other groups - Air Training Command and the using command. The Air Training Command personnel develop training concepts and plans for the system and assist in the acquisition of training equipment. The using command representatives assure that the ultimate customer's requirements are continuously reflected in the systems planning and actions during acquisition.

System Management Arrangements

The in-house approach to system management was not initiated with the SCAD program. It is a concept which goes back to the early days of weapon system acquisition. It has evolved over the years and has been used at various times in varying degrees. This portion of the chapter discusses that evolution process, five basic management arrangements between the government and contractors, and defines the in-house approach.

A Brief History of Air Force Contractor Management Arrangements. Prior to World War II, when weapon systems were relatively simple, the most efficient acquisition process was one wherein the military itself developed and produced its weapons. The military had the necessary personnel, laboratories and shops in which to design and produce the limited numbers of weapons required. This approach is commonly known as the arsenal concept. If a system was too complex or the military manufacturing capability was exceeded, then one of two other approaches was used. The services might negotiate contracts with industry for the production of components, yet retain the responsibility for research, development and system assembly/integration; or the military departments would issue a weapon requirement, circulate it throughout industry and invite the interested bidders to show up with a prototype model to compete for a production contract. Usually the winner would be provided with standard off-the-shelf components by the military in order to avoid having to pay a double profit on subcontracts. As aircraft became more complex and costly, a modified prototype concept evolved under which the military services specified certain hardware items and/or design features that were to be included in the weapon's configuration in the "Invitation-to-Bid." This approach and pre-contract stipulation not only helped to restrain development costs, but also minimized the requirement for new production and logistical support since many of the items identified in the procurement specifications were already in advanced development. The concept called for a military project engineer to be assigned the task of following the design and manufacture of each new piece of equipment. System components and subsystems were developed and produced independently of their integrated use in a weapon system until after World War II. The military services

were, in effect, buying major systems in bits and pieces from numerous contractors. (36:7-9, 46:2-5, 48:73)

Advanced technologies involved in jet aircraft and guided missiles in the immediate postwar years presented new problems. Each new component or subsystem, improved but more complex, had to work well with other new pieces in order for the total system to be effective. The design and development of airframe, propulsion, guidance, stability and control, test and support equipment, had to proceed in an integrated manner for each project. Without strict but costly and time-consuming controls, the process got out of hand. Component builders tended to lose sight of the ultimate weapon goal and instead optimized their component. When it appeared that the Air Force had neither the experience nor expertise to perform the requisite management, the complex system problems were contracted out to industry and the weapon system concept was born. The complete weapon system would be planned, scheduled and controlled from design through test as an operating entity. Under this concept a single prime contractor was selected to develop the system based on his proposal explaining how he would perform the necessary integrated systems engineering to meet Air Force requirements. Within the Air Force a form of system/project management was adopted wherein methods were developed to control the contractor's technical and management functions. The assignment of overall system engineering responsibility to the prime contractor meant that the principal engineering duty for the project office became one of monitoring contractor activity rather than actually performing engineering tasks. The result was a proliferation of staffs, paperwork, management systems, detailed procedures and regulations. (46:5-7, 75)

The full magnitude of the complex interactions between all the subsystems necessary for a weapon system to meet its mission was realized when the ballistic missile program was undertaken. Because of shocking developments and advances in missile technology by the Russians, great urgency was placed on expediting the acquisition process which had become encumbered in paperwork and procedures. An Intercontinental Ballistic Missile (ICBM) Advisory Committee was convened to review the acquisition organization and make recommendations for improving ICBM acquisition. The committee rejected the use of a single prime contractor for the program on the ground that no single industrial organization possessed the necessary range of skills and overall capability necessary. Furthermore, the Air Force did not have experienced management nor sufficient engineering talent to properly specify the performance characteristics. A unique arrangement was recommended and adopted whereby the Air Force project office would be advised and assisted by a special contractor. This contractor (Ramo-Wooldridge Corporation) was charged with assembling the scientific and industrial skills needed to perform all system engineering and technical direction for the program. Development and fabrication of major subsystems was contracted to "associate contractors." They, in turn, delivered their components to a contractor who was responsible for assembly and checkout of the entire system. The Air Force Program Manager was responsible for acquisition of the weapon system, but all major system engineering and integration decisions were executed by the system engineering and technical direction (SETD) contractor. (46:7-9)

While the Space and Missile System Organization (SAMSO), in charge of missile acquisition programs, has continued to use SETD contractors

such as Ramo-Wooldridge, Space Technology Laboratories and Aerospace Corporation, the manned aircraft system acquisition establishment, Aeronautical Systems Division, has been reluctant to shift from use of a prime contractor. Faith in the existing organizational arrangements and responsibilities has been reiterated and little interest shown in SETD contractors.

Gradual but sporadic attempts have been made at ASD to regain some of the system integration responsibility sold off to prime contractors. Two notable attempts at this return to in-house Air Force acquisition management prior to the SCAD program were the X-20 Dyna Soar and Gunship programs. The Dyna Soar program envisioned use of available in-house technical competence for "technical direction via leadership in lieu of review and veto." The program office would be responsible for systems analysis, system design and technical integration. The proposed in-house approach was touted as a pattern for management of complex advanced development systems of the future, but the program was cancelled before much use of in-house talent could be made. (7)

The Gunship program was more successful and long lived than Dyna Soar but at the same time was much less complex. After a short period of using a prime contractor to modify existing aircraft to Gunship configuration, the program office began providing overall design and layout concepts to an installation contractor who, in turn, provided the detailed production engineering drawings for fabrication and installation of selected components. The installation contractor fabricated many of the components, installed all of the subsystems, and performed all of the functional tests. The program office decided necessary subsystem design compromises, defined the required subsystem

and system interfaces, and monitored all tests. (30:33-56)

Thus, over the years the Air Force has assumed a varied management role. At times, total use of in-house talent was made as weapon systems were conceived, designed, developed and produced with military resources. At the other extreme, the Air Force has often times relied solely on a prime contractor or SETD contractor to fulfill its weapons requirements. And in between, there have been occasions when the Air Force would either assemble components themselves or, retaining the integration responsibility, hire an associate contractor to assemble the subsystems.

Basic Management Arrangements. While there are an infinite number of possible management arrangements which may be utilized covering a continuum from total government resources to total industry resources, five basic options can be delineated.

Arsenal. Under the arsenal approach the government is totally responsible for accomplishing system design, development, testing and production. No use of industrial contractors is made. This is the purest form of in-house management.

Associate Contractors - Integration and Assembly by DoD. One step removed from the arsenal approach is an approach utilizing associate contractors to furnish components or subsystems which meet government specifications. Government personnel are responsible for design of both the subsystems and the total system through interface specification. Once the components are produced and delivered, the government is responsible for integration, assembly and checkout of the entire system. Total system performance is the responsibility of the government.

Associate Contractors - Integration by DoD - Assembly by Contractor. Moving further along the spectrum, another plausible arrangement would be to use several associate contractors to produce the necessary subsystems. Under this arrangement, one contractor is responsible for assembling and checking out the components as they are produced. Responsibility for design, system and subsystem specifications, interface definition and system integration remains with the government, who furnishes the components to the assembly contractor (usually the airframe contractor) as Government Furnished Equipment. Again, the ultimate responsibility for weapon system performance rests with the government.

Associate Contractors - Integration and Assembly by Contractor. Under this arrangement, associate contractors would again be contracted with for production of subsystems and one contractor would be responsible for assembly and checkout of the total system. In addition, a contractor would be hired to perform the system integration job of performing system engineering and giving technical direction. This contractor may perform the SETD function only or may also serve as the assembly and checkout contractor. At any rate, he would be the "most associate" contractor since his job would include total system responsibility. The government's role under this arrangement is one of monitoring each of the associate contractors.

Prime Contractor. A prime contractor is responsible for system integration as well as the design, development, production, testing and evaluation of the weapon system. Some subsystems may be contracted for directly and delivered to the prime as Government Furnished Equipment, but the prime still has overall responsibility for total system

performance. In this instance the government monitors the progress of the prime contractor and through surveillance and control procedures insures that all contractual obligations are met.

The In-House Management Approach. The in-house approach to weapon system acquisition management can be defined as that approach utilized whenever the government assumes responsibility for total system integration and the resulting performance. System integration and who performs it is the key to defining the in-house approach. Recalling from earlier discussion, system integration occurs whenever system engineering is applied and technical direction is given. If the government accepts the responsibility for integration of the weapon system components and the associated responsibility for total weapon system performance, it adopts an in-house approach. This approach may vary in the management arrangement utilized between the government and contractors. It encompasses the first three arrangements discussed above or some variation of those arrangements so long as the government retains its role as system integrator. With reference to Figure 2, which shows the five basic government/contractor arrangements, one could say that in-house management is applied in the area to the left of the dashed line.

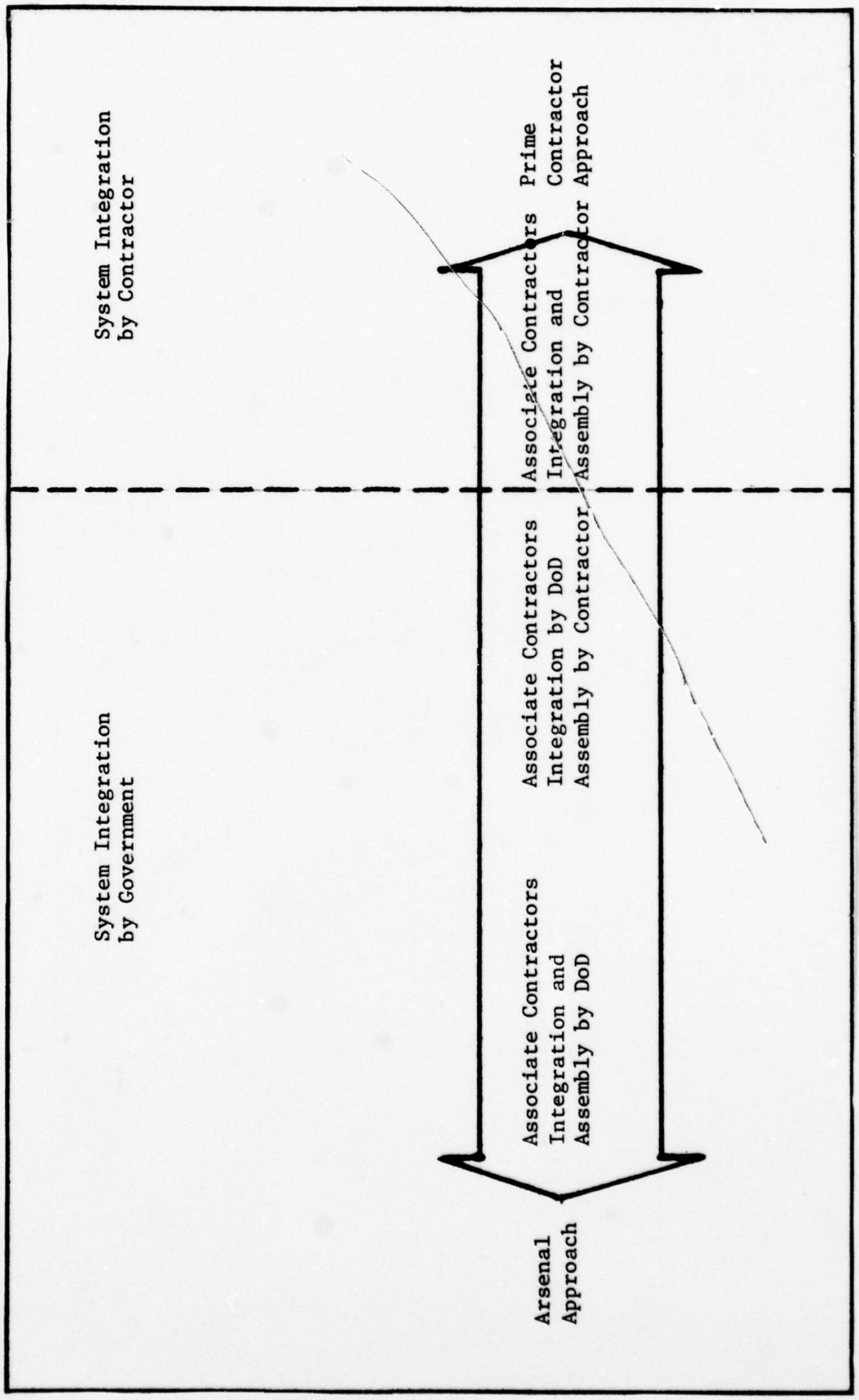

Fig. 2. Basic Management Arrangements

III. History of the Subsonic Cruise Armed Decoy (SCAD) Program

Prerequisite to a thorough understanding of a management approach and its application on any program is an understanding of the program itself and the environment in which it functioned. This chapter presents a chronological history of the Subsonic Cruise Armed Decoy (SCAD) Program from conception to termination. Information included in this chapter is taken from historical documents provided by the SCAD Program Office and the ASD Historian except where otherwise noted. For the reader who is not familiar with terms associated with weapon system acquisition management, a glossary of terms used in this chapter is included as Appendix C.

Conceptual Phase

In the mid-1960's Department of Defense and Air Force bomber penetration studies indicated a need for an improved decoy for the 1970's and 1980's as a replacement for the aging ADM-20C Quail. In July 1967, Headquarters Air Force Systems Command (AFSC) further directed a study toward the conceptual feasibility of a Subsonic Cruise Attack Missile (SCAM) to be utilized by the strategic bomber force. Aeronautical Systems Division (ASD) subsequently awarded conceptual study contracts to Beech Aircraft Corporation, Lockheed Missile and Space Company, and The Boeing Company.

In January 1968, the Strategic Air Command (SAC) issued a Required Operational Capability (ROC) for an improved decoy. SAC wanted a low cost, credible, reliable, unarmed B-52 decoy which would be compatible with the proposed B-1, then known as the Advanced Manned Strategic Aircraft. SAC stated that they recognized that a warhead may ultimately become a necessity to preserve credibility of the Subsonic Cruise Aircraft

Decoy, but that another ROC would be issued when that determination was made.

On 12 January 1968, a Requirements Action Directive (RAD) was issued by Headquarters United States Air Force (USAF) to AFSC which officially identified SCAD as a Subsonic Cruise Armed Decoy. This document superseded a RAD that had been submitted just three weeks earlier initiating efforts on a pure bomber decoy. The new RAD called for preparation of a Concept Formulation Package/Technical Development Plan (CFP/TDP) for an air launched missile system which could operate as an attack missile and/or a bomber decoy. The deadline for submission of the CFP/TDP was 1 June 1968. Because of the short deadline, it was directed that ASD accomplish an in-house concept formulation study upon which to base the SCAD CFP/TDP. The in-house study was greatly reduced in scope compared to the contracted studies which would not be completed until July. Both the ASD and contracted studies indicated that the concepts were technically feasible and provided good flexibility for application as either a decoy, armed decoy, or attack missile. Neither study resulted in an approved program, however. According to the General Accounting Office:

> "Disagreements within the Air Force over the SCAD concept developed in late 1968. SAC wanted an early Initial Operational Capability (IOC) unarmed decoy which would aid bomber penetration and was willing to accept a modified drone if it were a credible B-52 decoy. SAC did not want the development of a decoy delayed because of the complexity, higher costs, and additional risks associated with

> arming. The Air Staff and AFSC wanted a longer range armed decoy. It would be procured through a longer, more conservative, development strategy and be compatible with the B-52 and B-1." (28:6-8)

On 7 October 1968, a SCAD Program Office cadre was established; this ZAGM-86A System Program Office was under the operational control of the Deputy for Development Planning and operational control of the Deputy for Systems Management. In January 1969, Lieutenant Colonel R. B. Shaw became SCAD's first Program Manager.

One of the major reasons for the differences in opinion on the SCAD concept was skepticism within DoD that a credible decoy could be developed. Those in favor of an armed system argued that if SCAD were armed it would allow for a more flexible system by providing a discriminant hedge. If warheads were carried on even a few of the decoys, all such vehicles would be credible targets and would necessitate attack by enemy defense systems even if the decoys could be discriminated from the launch aircraft.

Since neither of the previous studies had adequately addressed decoy electronics, two additional studies were initiated in June 1969. Both Raytheon and Philco-Ford concluded in these studies that they could build a decoy package to simulate the B-52 and still meet the size constraints.

In order to further narrow the spectrum of potential design concepts for the SCAD system, a second set of system design study contracts was awarded to Beech, Boeing and Lockheed in June 1969. The main study tasks were: (1) to provide design and performance information on configurations that would be interchangeable with the Short Range Attack Missile (SRAM)

for both internal and external B-52G/H carriage, (2) to select optimum turbofan propulsion systems for each vehicle configuration, and (3) to provide schedules and cost estimates for various development strategies. These studies, completed in late 1969, confirmed the concept of the previous studies, and it was again concluded that SCAD was feasible in any of several configurations.

A second ROC was issued by SAC in September 1969 due to a lack of positive acquisition decisions on the previous ROC. This ROC re-emphasized the need for a B-52 decoy by the early 1970's, and requested a flight test of an electronic decoy package in order to demonstrate decoy credibility and provide a basis for full scale development. As a joint SCAD Program Office/Avionics Laboratory project, a decoy flight test program was initiated in December 1969. It involved development and flight test of a decoy package covering major Soviet threat radar frequencies. Using off-the-shelf amplifiers, a decoy system was packaged and incorporated in a flight pod. The pod was mounted on an F-4C. The F-4 and a jamming B-52 were flown against simulated Soviet ground and airborne radar at Eglin Air Force Base. Throughout the flight evaluation program, conducted in 1970, experienced radar operators were unable to discriminate between the B-52 and decoy target.

Based on the results of the decoy flight test program, the Air Force gained sufficient confidence that a credible B-52 decoy could, in fact, be developed. The Chief of Staff of the Air Force on 12 December 1969, called for a two-phased approach to SCAD development. The first phase involved the procurement of an unarmed B-52 decoy, with an early operational deployment. The second phase called for an advanced armed decoy, compatible with the B-1. The SCAD Program Office consequently

initiated studies to determine the feasibility of modifying existing missiles or drones to perform the first phase mission. Meanwhile, Colonel A. L. Wood succeeded Lieutenant Colonel Shaw as Program Manager in mid-1969.

Early in 1970, the Air Force prepared a draft Development Concept Paper (DCP) in order to resolve issues and obtain a consistent Air Force/ Office of the Secretary of Defense (OSD) position on the program. Three options were included in the DCP which reflected the differences of opinion within DoD on the concept. Option 1 called for a B-52 decoy sized to be compatible with the SRAM rotary launcher. It would not be armed, but would be designed to allow for arming at a later date if required. Option 2 was a more sophisticated system which also allowed for greater flexibility. It would provide an armed decoy with an attack capability. Option 3 was for an attack missile which would give the bomber force a long range stand-off capability.

During coordination of the DCP all three options were supported. The Air Force backed Option 1, Defense Research and Engineering preferred Option 2, while Systems and Analysis liked Option 3. On 15 July 1970, the Deputy Secretary of Defense, David Packard, approved initiation of advanced development for SCAD along the lines of Option 1 - an unarmed decoy constrained in size for internal carriage with the alternative of arming at a future date.

The Program was now ready to enter the Validation Phase.

Validation Phase

Late in 1970 several TDP's were developed but none were approved because of disagreements over the development strategy and proposed costs and schedules. Colonel Wood was reassigned in November and Mr.

Julius Singer, former Assistant Program Manager, became SCAD's third director.

In an effort to get SCAD "off the ground", an ASD study committee was established in November 1970. This committee, led by Mr. Singer and Mr. John E. Short, the ASD Commander's Assistant for Special Projects, developed a three phase development strategy for SCAD. The first phase, Scramble I, would be a six to nine month contracted electronic countermeasures payload development program followed by a flight test demonstration. Scramble II would employ ASD resources and facilities in preliminary design and development planning. The third phase was a development, acquisition, test and evaluation program. This strategy was temporarily halted when Congress failed to appropriate $10 million requested for SCAD in fiscal year 1971.

The AGM-86 Program Office was transferred from organizational control of the Deputy for Development Planning to the Deputy for Reconnaissance, Strike and Electronic Warfare on 1 February 1971. In Feburary 1971, the Scramble plan was presented to AFSC and Air Force headquarters. The Scramble I portion was deleted since the Avionics Laboratory decoy credibility program would adequately demonstrate SCAD's credibility. The Air Staff accepted the remainder of the strategy which placed ASD in a prime contractor position with five subsystem contractors (airframe, engine, decoy electronics, navigation/guidance, and carrier aircraft equipment). This plan, which provided for a 42 month development program, was approved by the Secretary of the Air Force on 23 April 1971. In a message to the Commander of AFSC, General Ryan put his personal endorsement on the development approach by stating:

"The program proposed in the SCAD Technical Development

> Plan ..... has been reviewed by SECAF/RD and OSD/DDR&E Staffs and is approved in principle. I encourage sustaining the spirit and motivation of your command associated with the in-house approach proposed for SCAD." (39)

This TDP, entitled the "Accelerated Development Plan," which featured an associate or subsystem contractor structure with the program office assuming the role of a prime contractor responsible for system integration, became the baseline plan against which future modifications were measured.

In June 1971, Headquarters USAF issued System Management Directive SMD1-461-689(1)-(AGM-86A) to AFSC to initiate the SCAD development program in accordance with the approved development plan. The SMD included the following features: (1) only an unarmed version of SCAD was to be developed, with physical provisions to allow arming later, (2) a study effort would be initiated to extend the range, and (3) compatibility with B-1 was to be a secondary objective with B-52 decoy performance the primary objective.

Based on this direction, the program office worked on preparation of specifications, Statements of Work, and other Request for Proposal (RFP) materials under the direction of Colonel Jay R. Brill, who became Program Manager on 29 July 1971. On 12 August 1971, the Air Force completed negotiations with Cornell Aeronautical Laboratory, Inc., to provide engineering and technical assistance to the SCAD office in areas where ASD resources were limited. In September, ASD forwarded the Determination and Findings requesting authority to negotiate the AGM-86A subsystems and additional studies to Systems Command headquarters. On

the same day, however, Headquarters USAF informed AFSC that Deputy Secretary of Defense Packard had issued a Program Decision Memorandum which contained a new funding arrangement for the SCAD program and would constrain the funding levels required for the approved development plan.

Headquarters AFSC then requested that ASD present alternative SCAD development plans. By 11 November, the AGM-86 office had submitted three alternative plans. One was a redocumentation of the April 1971 Accelerated Development Plan which had previously been approved. The second plan was modified to show the full impact of the funding constraints. And the third was a partially constrained plan which maintained Secretary Packard's funding for fiscal years 1972 and 1973, but was unconstrained in 1974 and out years. It allowed for more timely accomplishment of the program objectives than the fully constrained development plan. Before approval could be granted on one of these plans, however, new direction from still another source changed the program.

In July 1971, OSD issued DoD Directive 5000.1 which modified program management responsibilities, authorities and the sequencing of acquisition actions. New emphasis was placed on prototyping in lieu of paper studies of the McNamara era. Secretary Packard presented the idea of prototyping to Congress in September and the legislators reacted enthusiastically. The House of Representatives Committee on Appropriations directed that the development of SCAD be conducted under competitive prototype procedures.

As a result of this direction, the program office prepared several additional alternative plans in December 1971. In January 1972, the decision was made by the Air Staff to proceed with the April 1971 development plan, partially constrained by meeting the new funding levels in

fiscal years 1972 and 1973. In addition, a competitive engine prototype program would be incorporated. Two engine contractors would be required to develop engines for a performance demonstration so that the competitive prototype program requirement could be met. A single contractor would be selected, based on the results of the performance demonstration, during the first year of full scale development.

By the end of January the program office incorporated these changes into a revised development plan and submitted it to Headquarters USAF. General Ryan approved the plan on 1 March and directed that the SCAD program should proceed without further delay. A Program Management Directive (PMD) which replaced the SMD, was received in the program office within a week. However, by this time the program had been revised and delayed such that when compared to the originally approved plan the General Accounting Office found: "...Indecision, disagreements, and other factors have caused slips in the milestones for the SCAD program. There has been a 10 to 12 month slip in the Contract Award milestone, a 23 month slip in the First Flight milestone, and a 30 to 36 month slip in the Initial Operational Capability (IOC) milestone."

RFP's for all segment contracts were released to industry on 14 February. A competitive source selection process began and by July six contracts totaling over $150 million were awarded. The Boeing Company received two contracts; one for the development of the airframe and assembly of the air vehicle, and another for modification to the carrier aircraft equipment. Litton Systems, Inc. was awarded the navigation/guidance contract. Philco-Ford Corporation got the contract for development of the decoy electronics. Williams Research Corporation and Teledyne-CAE Division were selected to perform the prototype engine

development and competitive demonstration.

Thus, after a lengthy validation which was characterized by continuous redirection, the program proceeded into full scale development.

Full Scale Development

Before entering into full scale development, a system should be well defined and free of most unresolved issues. The SCAD program, however, still had several issues which could be considered as unresolved.

Primarily, the issue of arming was still around. Advocates of arming still argued that the decoy needed to be armed to provide a hedge against decoy discrimination. They found an ally in Senator Proxmire, who stated that the Air Force was "dragging its feet" in developing SCAD in order to keep the B-1 program, currently in engineering development, out of jeopardy. The Senator suggested that an attack version of SCAD could provide us with an alternative option to the B-1 for preserving our strategic bomber force. Another issue was the range of SCAD. If the SCAD were armed the warhead would displace fuel and result in a range less than adequate for a stand-off missile. (77:170-171)

Still another unresolved issue was the B-1 compatibility issue. Slips in the development schedule of SCAD, due to all the replanning required, now made the SCAD deployment coincide with the B-1. There was also some question about the B-52 still being in the inventory by the time SCAD would be available.

In view of all these unresolved issues, the Defense Systems Acquisition Review Council (DSARC) which would normally precede full scale development was delayed until November 1972. In an effort to resolve the issues, the program office developed plans and authorized trade studies on all the issues.

The date of the DSARC meeting was changed several times, but in January 1973 it was indefinitely postponed. On 16 February 1973, the program manager briefed the Secretary of the Air Force, Robert C. Seamans, on alternative SCAD configurations. The presentation covered AGM-86 effectiveness analysis, performance, scheduling, and the cost of various designs. Dr. Seamans then authorized the SCAD office to brief the DSARC, presenting the contemporary AGM-86A configuration as the recommended Air Force program. By this time, a preliminary design of the unarmed B-52 decoy was well in hand and development was proceeding on schedule. Figures 3 through 6 show the contemporary design and configuration. Figure 3 illustrates how SCAD could be carried on either pylons or the SRAM rotary rack. Figure 4 shows the activation of SCAD's foldable surfaces immediately after launch. Figures 5 and 6 indicate the configuration and contractors responsible for each major subsystem.

On 15 March 1973, the approved SCAD development program, along with alternate capability study results, were presented to the DSARC. The Air Force did not get a continuation decision, however, pending further illumination and resolution of requirements issues between OSD and the Air Staff. In addition, there was a request by the Office of the Secretary of Defense/Director of Defense Research and Engineering (OSD/DDR&E), John S. Foster, Jr., to develop another program option - the simultaneous development of both armed and unarmed SCAD vehicles. Dr. Foster requested a follow-up DSARC and it was scheduled for mid-April. On 13 April the DSARC presentation was made but again no firm program decision was reached. In May, the program office was directed to rebrief the DSARC in late June.

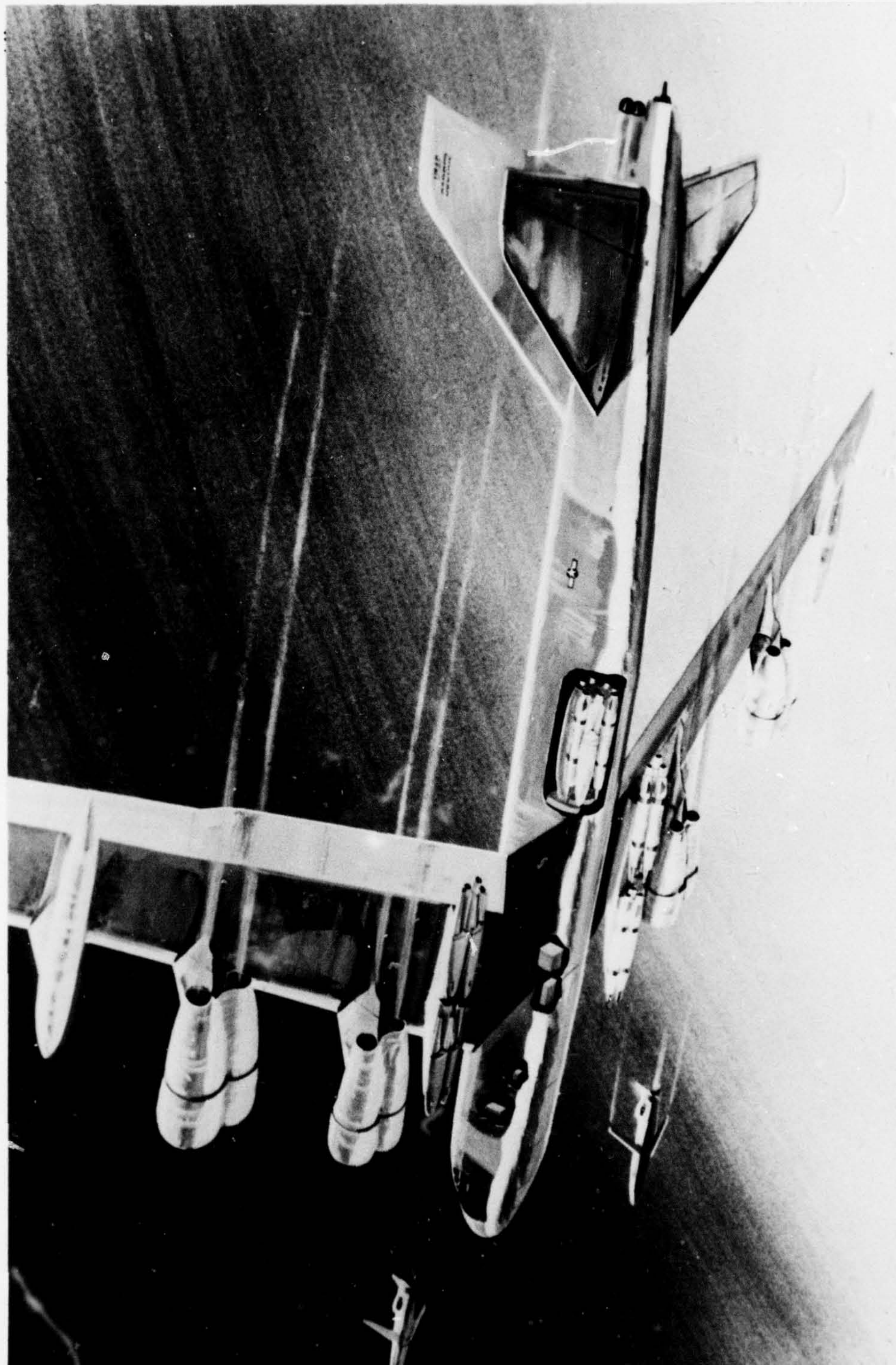

Fig. 3. B-52 Carriage of Subsonic Cruise Armed Decoys

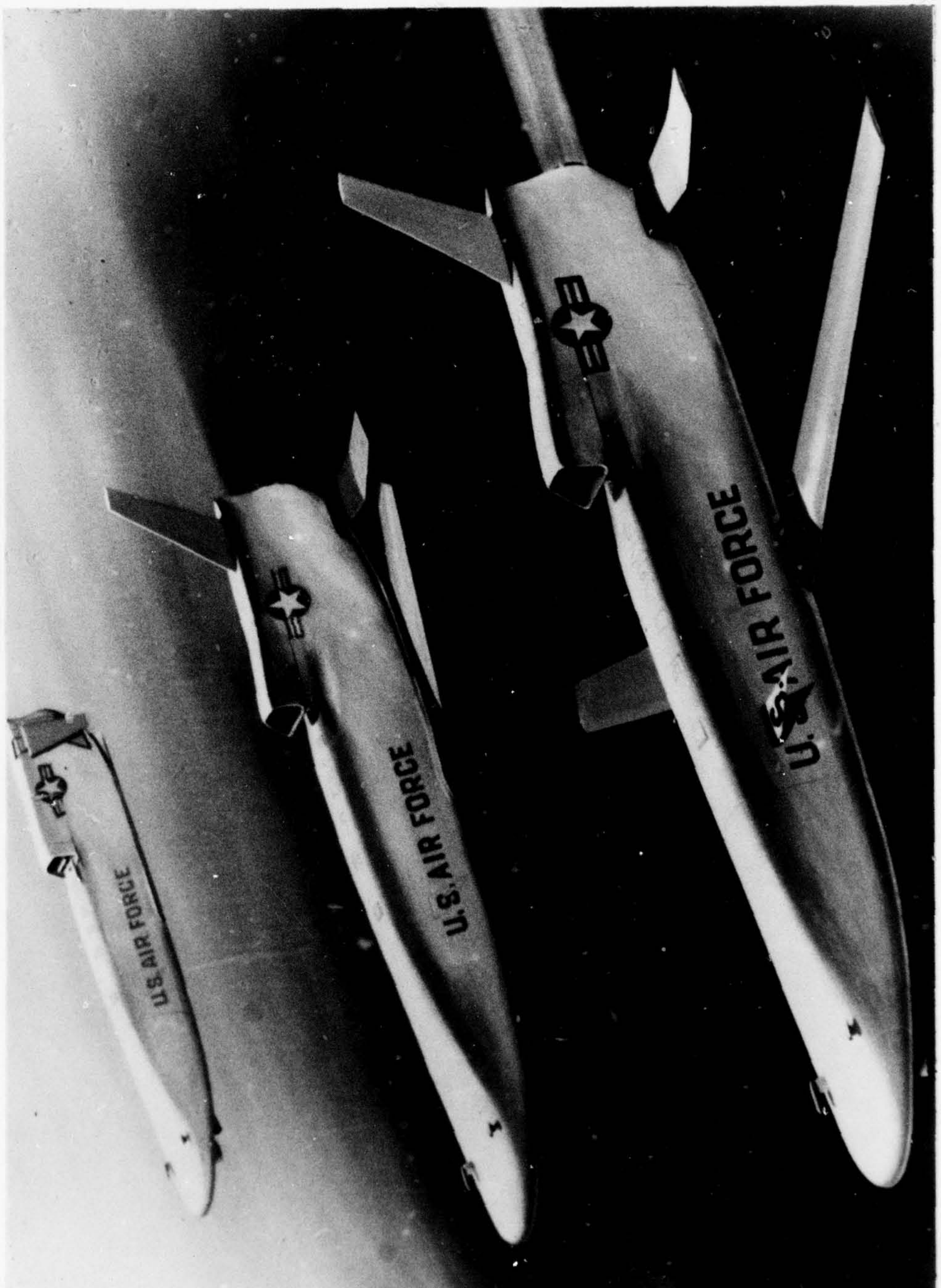

Fig. 4. Subsonic Cruise Armed Decoy Launch Sequence

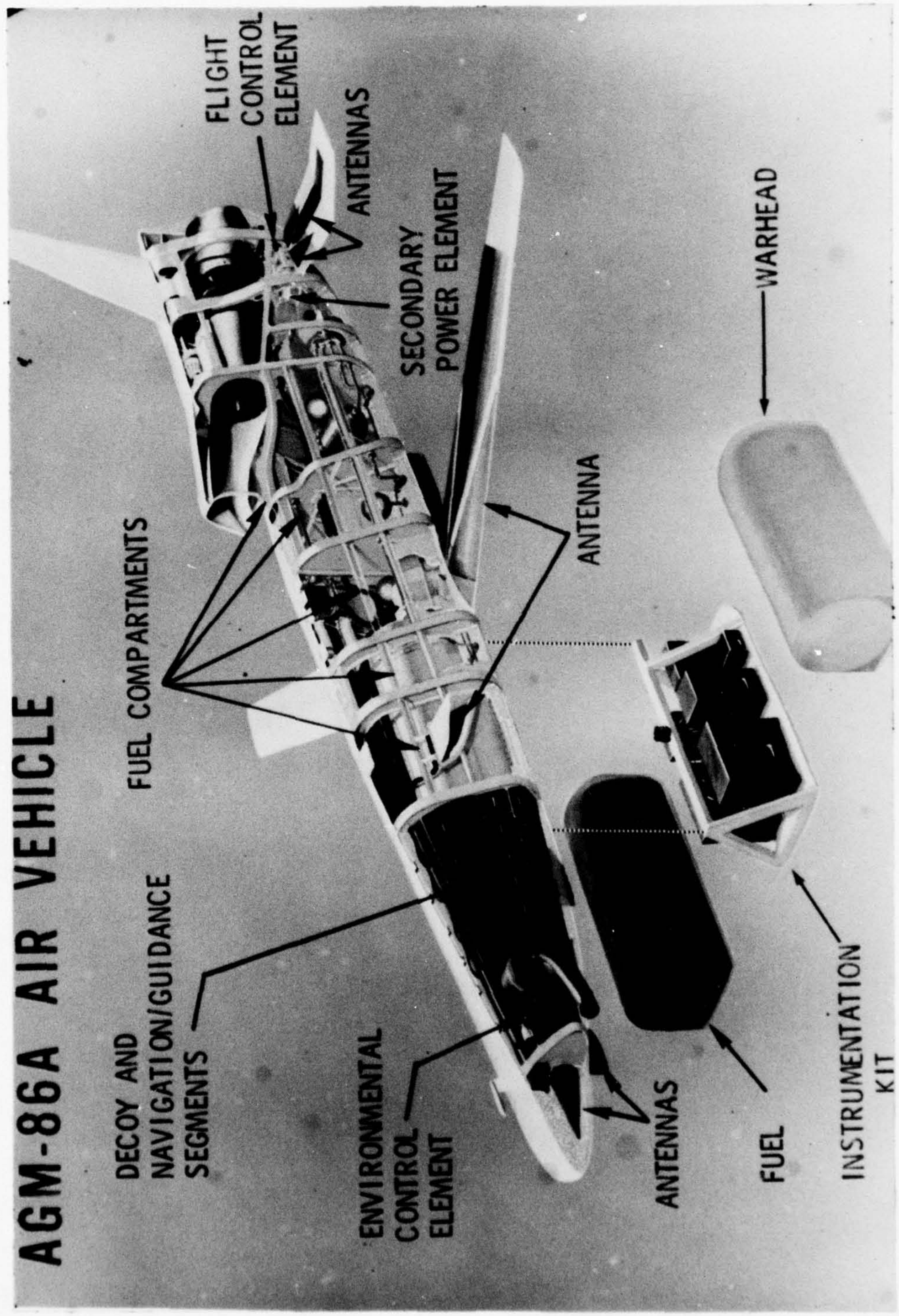

Fig. 5. Preliminary Design Configuration

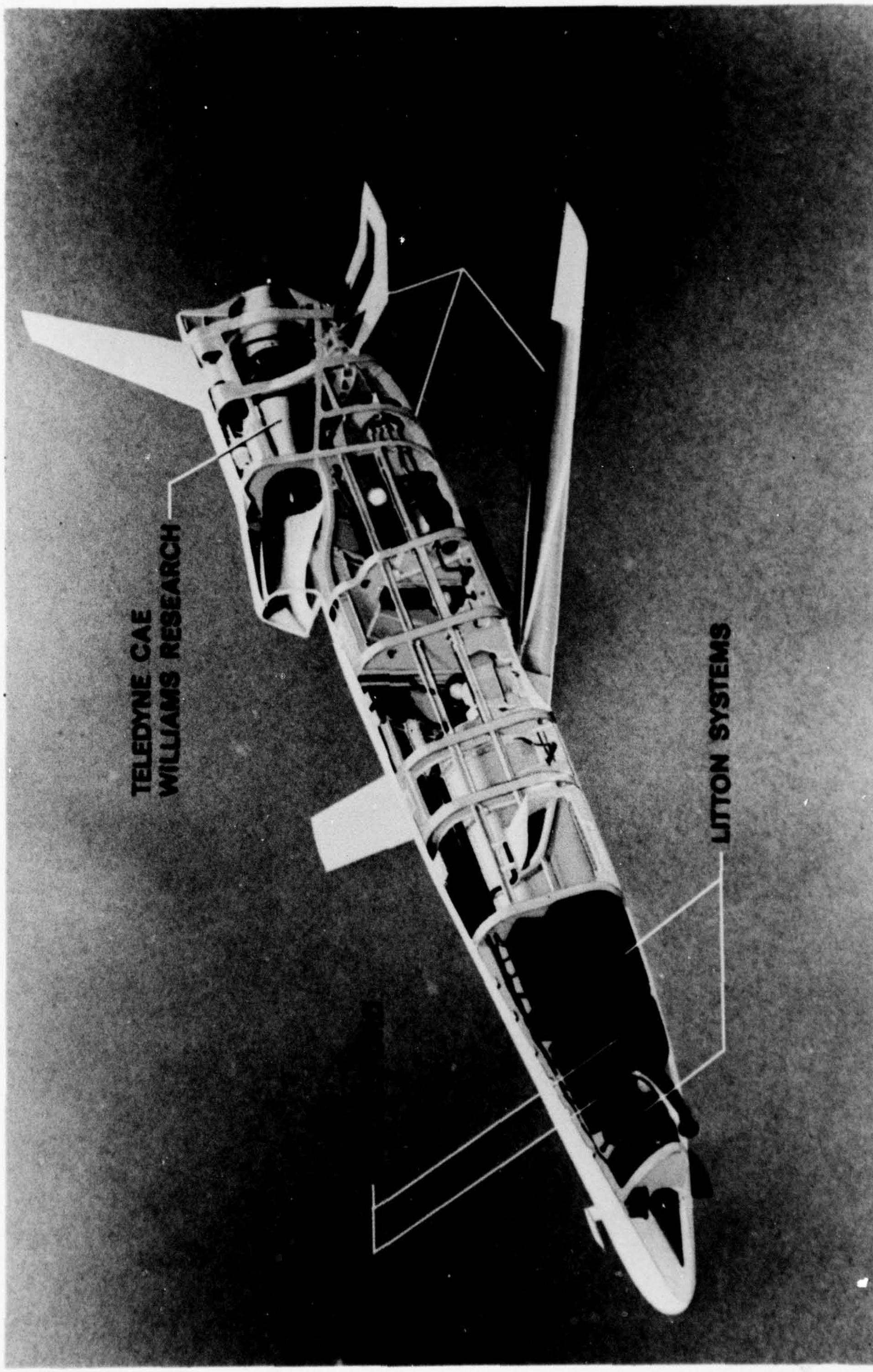

Fig. 6. Associate Contractor's Segments

Termination

Meanwhile, rumors of cancellation were descending on the program office. One of the earliest was an article in Aerospace Daily on 5 April, which was entitled "SCAD Seen in Danger of Cancellation." The article reported that while some people in DoD Systems Analysis and some congressmen supported the program, there was considerable opposition to it within DoD and the Air Force, including Secretary Seamans. (69:201)

The final SCAD DSARC review was held on 28 June. After the presentation, Air Force members were excused while the DSARC went into executive session. On 9 July, the program office received the DSARC decision:

> "...Following a meeting of the Defense Acquisition Review Council on 28 June 1973, the Deputy Secretary of Defense has decided to terminate the full engineering development of SCAD." (40)

Thus, after some five years and approximately $65 million, the SCAD program died amidst indecision and disagreement.

IV. Subsonic Cruise Armed Decoy Program Management

The purpose of this chapter is to analyze the SCAD approach to in-house management. The management philosophy is explained and the rationale for adopting that philosophy is presented. Next, the program office organization is described along with certain unique features of several of the divisions. Finally, the strengths and weaknesses of the approach as used by the SCAD Program Office are discussed.

SCAD's In-House Management Philosophy

Prior to November 1970, most of the development plans for SCAD called for two prime contractors to conduct a parallel development effort leading to a competitive flyoff of prototypes. The prime contractors would assemble their own development teams from interested subsystem contractors. Besides the airframe, which would be provided by the prime contractor, four subsystems had been identified: decoy, guidance, propulsion and warhead. The winner of the competitive prototype flyoff would continue development efforts in the full scale development phase and upon DSARC approval, produce the system. Plans based on this approach were never approved, however, since it was considered too conservative and costly in terms of both time and money. (73)

In November of 1970 following Colonel Wood's reassignment, General Stewart, ASD Commander, made an attempt to find a new way to "sell" the SCAD program. He directed Mr. John E. Short to look into the program and come up with a new approach which would be quicker and less expensive. Mr. Short's approach was the Scramble program discussed in Chapter 3. He saw the SCAD as a simple system; one so simple that the program office could handle the prime contractor's job, thus reducing the cost and

hopefully still meet an accelerated schedule. There were two possible management approaches in Mr. Short's opinion. They are shown in Figure 7. (16) Mr. Short's personal optimism was bolstered in early 1971 when he informally discussed the approach with several aerospace contractors. The Boeing Company, eager to get started on the program, reported to the Air Force in March that: (1) the Air Force acting as prime weapon system contractor with an associate structure would work well, (2) there were no excessive technical risks involved, and (3) the development program was practical on a short schedule. (23)

Meanwhile, Mr. Julius Singer, the SCAD Program Manager, had conducted a survey at ASD to determine if the in-house engineering talent existed and if so, to what extent. He had estimated that the job would require approximately 375 engineers on a full-time basis but found little support from the ASD Engineering Division. Programs such as B-1 and F-15 with higher priority would be manned first and SCAD, with a lesser priority, would get whatever was left. In Mr. Singer's opinion only a very limited in-house effort could be accomplished; there was no indication that time or money would be saved; a major effort would be required to organize for an in-house approach which might result in a 6-12 month program delay; and that the SCAD program was not a preferential candidate for in-house development due to a lack of resources and a potential delay in the program. (13) Nevertheless, the survey results were regarded lightly as the Scramble plan was briefed at higher levels.

According to many of the people interviewed during the research, support for the approach was based on: (1) a desire to show that the Air Force, and ASD in particular, had the ability to do the integration job; (2) a desire to develop the in-house capability at ASD; (3) the on-going

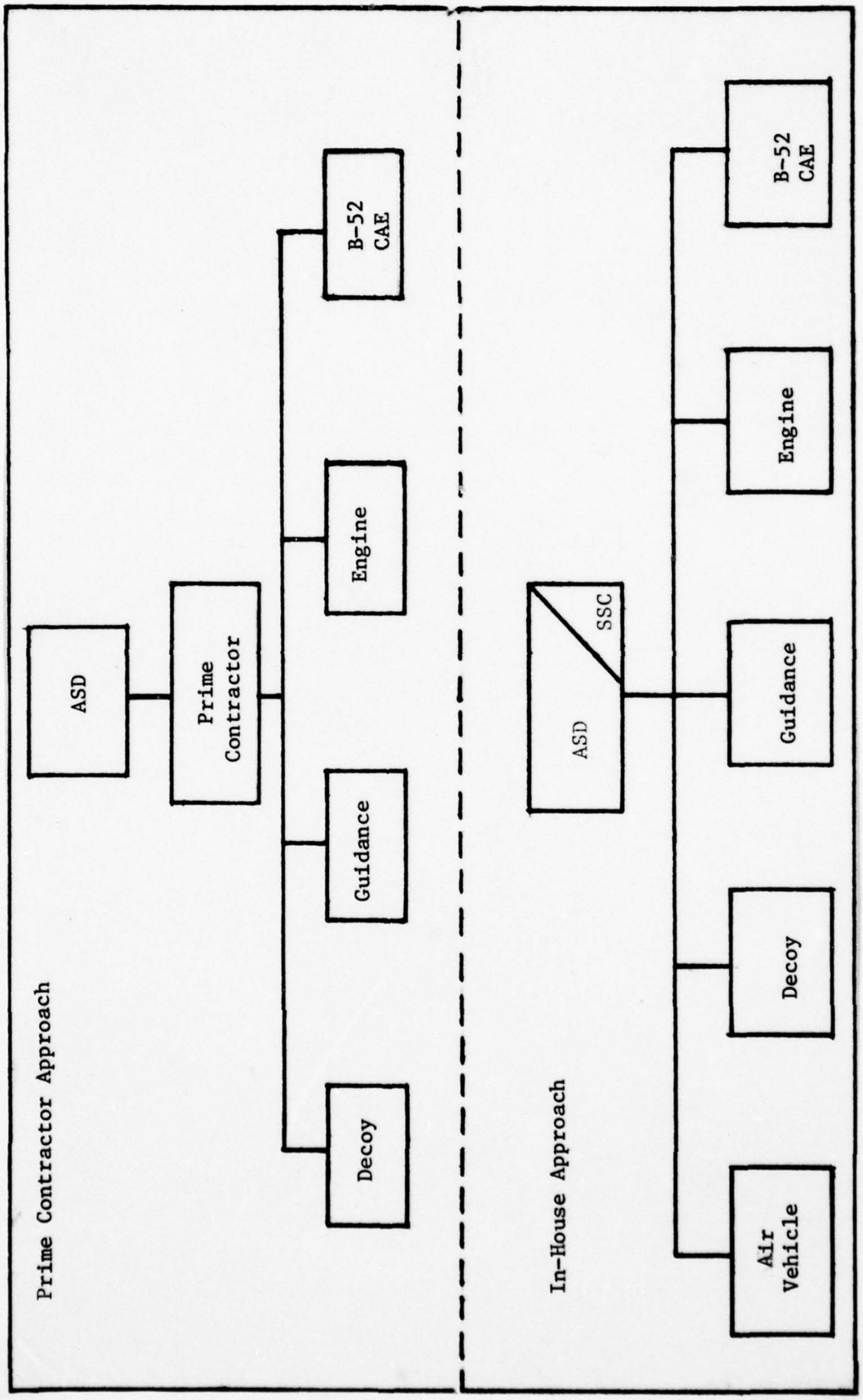

Fig. 7. Potential Management Approaches Considered

success of the Gunship program using the in-house approach; (4) a need for a fresh approach following recent failures on the C-5 and F-111 using the prime contractor approach.

General Stewart had asked for a way to get SCAD moving and Mr. Short responded. The in-house approach was the key selling point of the new SCAD program and it was well received at all levels.

The agreed upon Accelerated Development Plan of 23 April 1971 called for an in-house design effort which would culminate in detailed specifications for each of the major subsystems. Contracts would be awarded after a competitive source selection. All contractors would be associates with the program office acting as prime weapon system contractor. The program office would be assisted in its role by a system support contractor (SSC) who would provide "technician and other services which were not sophisticated or highly skilled in nature." (14) The airframe contractor would perform the assembly and checkout of the system, while the system tests would be performed by the Air Force.

Mr. Singer, who as program manager had opposed the in-house development approach, became assistant program manager under Colonel J. R. Brill in in 1971. Colonel Brill recognized that the task before him was not so simple as some people believed, and also saw the program growing much more complex as competitive prototyping was required by Congress and the arming debate continued. Colonel Brill knew that the program had been sold on the merits of the in-house approach, so he had to do the best he could with limited resources and a complex program. In his own words, Colonel Brill "structured the program based on the resources at hand."

The management concept adopted was one in which the program office assumed the responsibility for the system engineering and integration

functions, exclusive of detailed hardware design and fabrication. The program office prepared performance specifications and established general technical interface requirements and interface control procedures. It conducted trade-off analyses of technical performance, risk assessment, and costs.

A System Engineering/Technical Assistance (SE/TA) contract was awarded to Cornell Aeronautical Laboratory, Inc. to provide selected technical analysis and support. Specifically, the SE/TA contractor was tasked to provide system and threat analyses; risk analyses; modeling; trade studies; assistance in the areas of survivability, vulnerability, and reliability; B-52 electronic counter measures impact analyses; and decoy discriminant and credibility analyses. It should be noted that the SE/TA contractor provided only technical assistance and not technical direction. (11)

A primary aspect of the SCAD management approach was the utilization of an associate contractor structure for development of the system segments, with each segment developed under separate contract. The program office awarded major contracts for the airframe/air vehicle, engine, navigation/guidance and decoy segments, as well as the carrier aircraft equipment. The segment contractors performed on an associate contractor basis, with the airframe/air vehicle segment contractor responsible for assembly and final checkout of the entire SCAD vehicle. Initially two contracts were awarded for the engine segment, but one was terminated after the competitive engine demonstration.

Program Office Organization and Operation

The SCAD Program Office, in accomplishing the system integration task, interfaced with a number of other organizations as depicted in Figure 8. Early in the program representation in the program office from

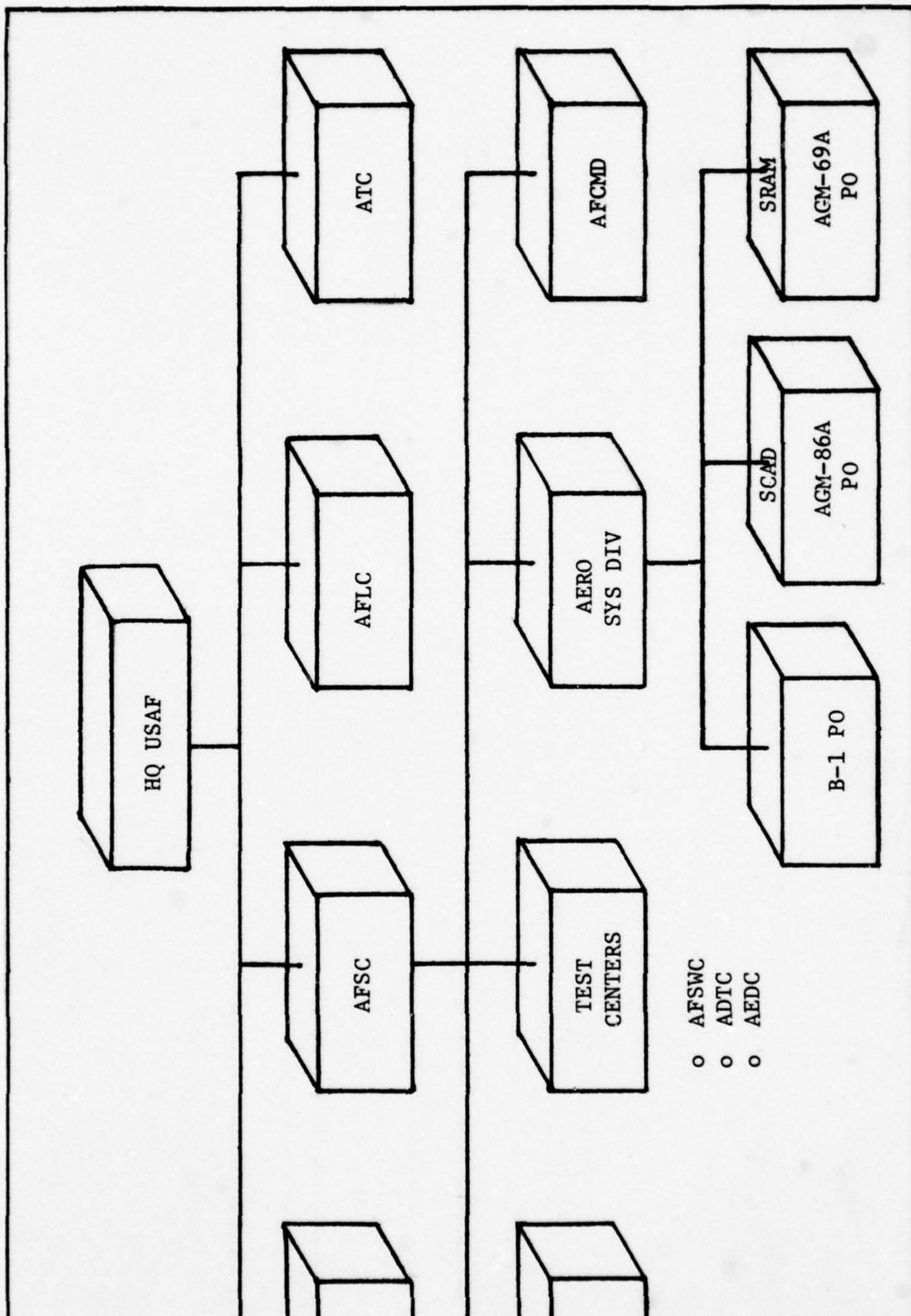

Fig. 8. Participating Organizations in the Program

SAC, the using command, and AFLC and ATC was established. Their participation and representation increased throughout full scale development. Continuing contact was maintained with various AFSC laboratories in an effort to focus all available in-house resources on SCAD technical areas. The Aero Propulsion Laboratory was responsible for helping with engine and component design and performance specifications. The Avionics Laboratory was tasked to provide decoy package design and to determine testing requirements. And the Flight Dynamics Laboratory aided in design, testing and specification determination for structures and flight controls. The test centers were also actively engaged in SCAD's development. The Air Force Special Weapons Center (AFSWC) was the Responsible Test Organization for the SCAD system test program. Flight tests staged from AFSWC were to be conducted at White Sands Missile Range (WSMR) and the Armament Development and Test Center (ADTC). The engine demonstration and follow-on testing was conducted at Arnold Engineering Development Center (AEDC). The Air Force Contract Management Division (AFCMD) provided a cadre to help prepare specifications and statements of work for SCAD requests for proposals. After contract award they moved to appropriate Air Force Plant Representative Offices as on-site representatives. Because of the required compatibility with the SRAM and B-1 systems the SCAD Program Office developed a close working relationship with both program offices. Formalized Memoranda of Agreement were signed between the three offices specifying the procedures to be followed to achieve compatibility.

Internally, the SCAD Program Office organizational structure was as shown in Figure 9. In addition to the usual program office divisions two additional entities, a System Analysis Group and a Projects Division,

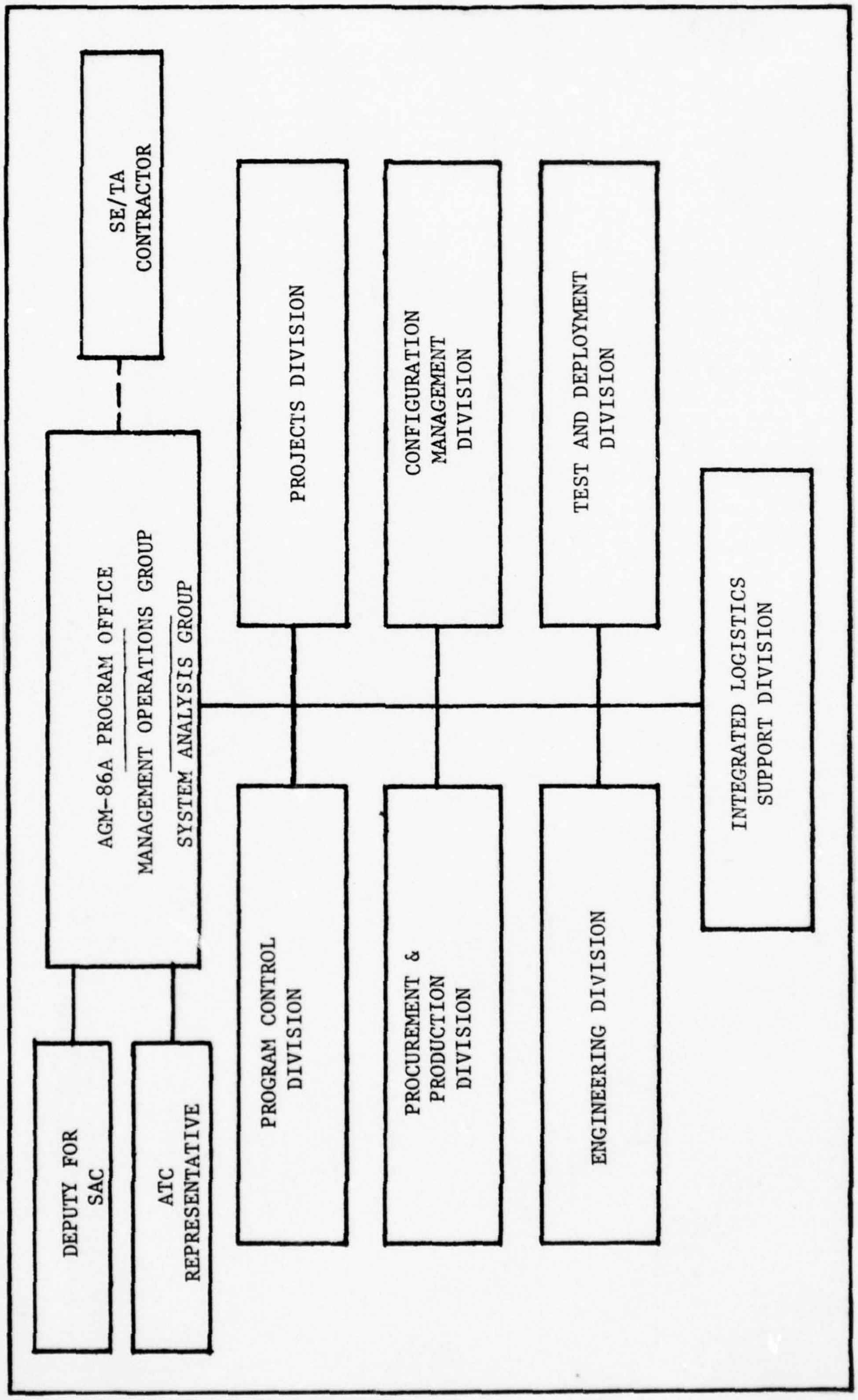

Fig. 9. Subsonic Cruise Armed Decoy Program Office Organization

were established. Their functions are discussed below, along with some of the unique and innovative functions of several of the other divisions.

System Analysis Group. The establishment of a separate System Analysis Group was in itself a unique SCAD feature. The office reported directly to the program manager, and was responsible for the performance of SCAD effectiveness studies, monitoring studies by other agencies, development of mathematical models in support of the program office, and for intelligence updating. To accomplish its intelligence task, the System Analysis Group established a Threat Working Group composed of representatives from Foreign Technology Division, DCS Intelligence at Headquarters USAF, DCS Intelligence at Headquarters SAC, the Air Force Weapons Laboratory and other program office divisions. The group provided a continuous threat updating capability and also provided technical intelligence data for SCAD system effectiveness model building.

Projects Division. The other unique entity within the program office was the Projects Division. It was made up of segment managers who were, in effect, mini-program managers for their designated subsystems. They operated as project managers in what is referred to as a matrix organization, drawing functional support from specialists in each of the other six divisions. Figure 10 shows how the organization structure appeared with the Projects Division overlaying the functional divisions. This overlapping gives the organization the appearance of a matrix and provides the name, matrix organization. The segment team members from functional organizations supported the segment manager, but he had no direct authority over them since they worked directly for their division chiefs.

The segment team and its manager were the central point of contact

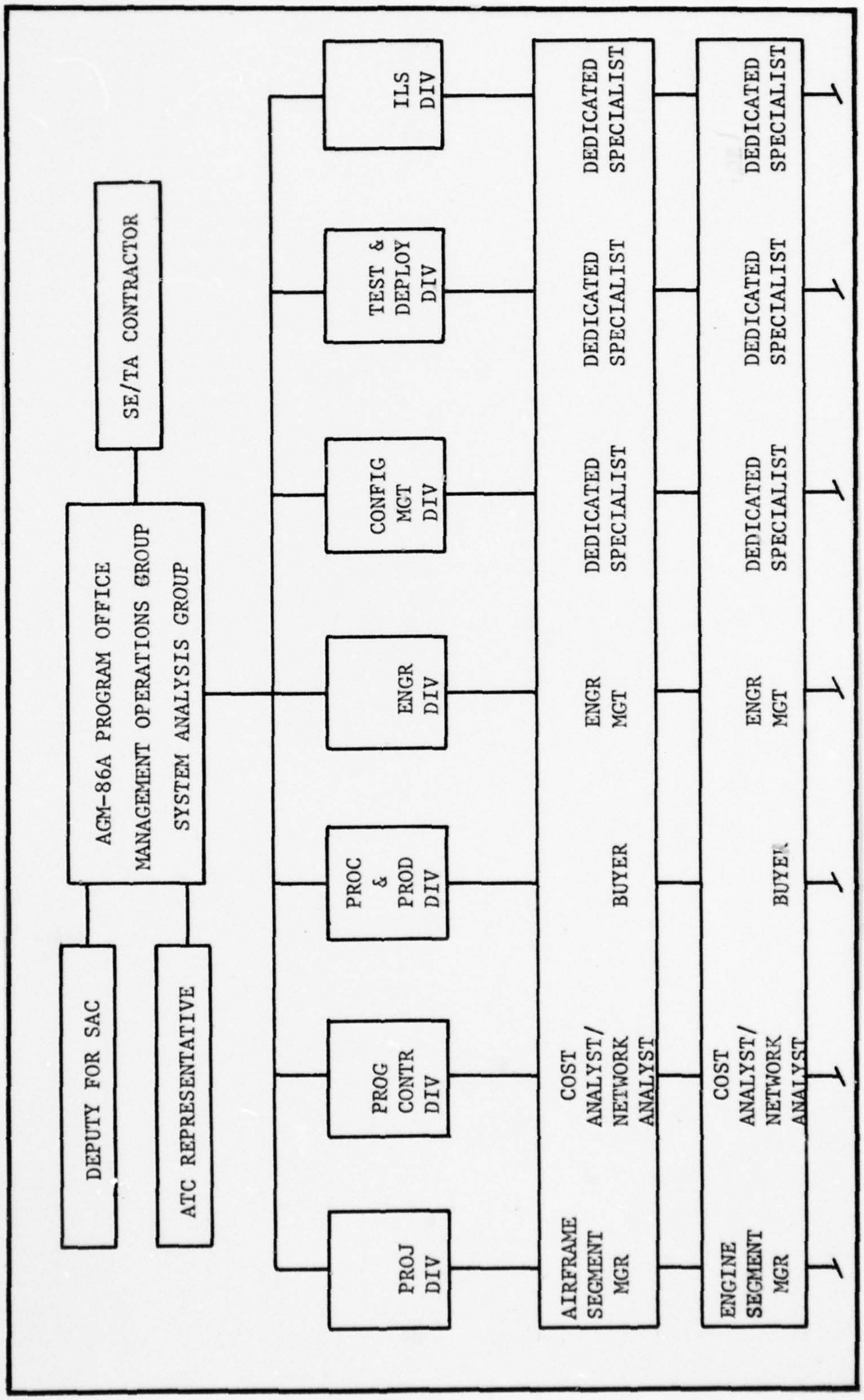

Fig. 10. Subsonic Cruise Armed Decoy - A Matrix Organization

with the respective contractor. Major correspondence initiated by the divisions was channeled through the segment managers for review and comments. The segment manager maintained daily communication with his contractor usually by telephone or through the local representative and made frequent trips to the contractor's facilities. He chaired monthly Segment Status Reviews at which the contractor summarized the program and highlighted current activities and problems. These reviews, usually held at the contractor's plant, covered cost, schedule and performance progress and, in general, kept the team informed and involved.

In addition to the segment managers, the Projects Division also employed a system integration manager. This position was not created until the Spring of 1973, however, and did not function long enough to comment on its merits. The integration manager worked closely with the system oriented engineers, configuration managers, segment managers, and members of Program Control's Evaluation Group in an effort to air and resolve system level problems. (66)

Configuration Management Division. The Configuration Management Division was given primary management responsibility for interface control. Immediately after contract award, an interface definition meeting was held at the program office to define and start working on the interface activities among the various segment contractors. Interface control activities required the associate contractors to establish working relationships with one another in order to establish and control all physical and functional interfaces between configuration items. The Configuration Management Division implemented an interface control program through which interface identification, documentation, and control activities were implemented. Continued interface program emphasis and

control was maintained through an Interface Control Working Group (ICWG).

The ICWG was a top level management tool which played a significant role in the technical definition and direction of the SCAD program. Elevated from the normal technical working group level, SCAD's ICWG brought together representatives from all associate contractors and affected government agencies to resolve interface problems and insure that technical compatibility was attained. The ICWG, chaired by the Chief of Configuration Management, elevated interface incompatibilities and interface definition to senior technical and management personnel for resolution through face-to-face discussions. Four ICWG meetings were held during SCAD's full scale development. (61, 66)

<u>Procurement and Production Division</u>. After a source selection procedure which included evaluation and negotiation of sixteen proposals in record time, the Procurement and Production Division awarded Cost Plus Incentive Fee type contracts to the six segment contractors. Unique aspects of these contracts were the Limitation of Government Obligations (LOGO) clause, Associate Contractor Agreement (ACA) clause, and the Air Vehicle Assembly and Checkout clause.

Although the Armed Services Procurement Regulation (ASPR) provides for the use of the LOGO clause in fixed price contracts, the funding constraints of the SCAD program made it necessary to obtain a one time ASPR deviation to employ the LOGO clause. Since the program office had prime responsibility for the financial management of the program, some means had to be devised to assure that sufficient funds would be available to enable development and testing efforts to be done on predetermined budget allocations by fiscal year. The LOGO provided for incrementally funding the contractors within fiscal years. One of the key features of

the LOGO was that if the government met its funding obligations in accordance with the schedule and amount, the contractor could not stop or reduce effort if he exceeded his funds within any given fiscal year. (66)

Another unique feature of the contracts was the ACA clause. The Associate Contractor Agreements were required to be consummated by the participating segment contractors to assure complete and unbiased exchange of technical information and data related to the design of the SCAD system. The contractors further agreed not to use proprietary data of the other associates in supplying future systems or components. (66)

In the absence of a prime weapon system contractor the airframe/air vehicle contractor was given the task of final assembly and checkout of the entire SCAD vehicle. The airframe/air vehicle contractor was also tasked to recommend to the government solutions to problems or actions necessary to assure that the assembled air vehicle would meet the technical specification requirements. He also had to concur with the technical specifications for the other segments and witness the government inspection and acceptance procedures for each segment. (66)

Program Control Division. Two innovative and unique efforts were performed by the Program Control Division. The first was the preparation and implementation of a Program Office Management Plan (POMP). It identified the tasks, responsibilities, and task methodologies to be followed by the various divisions in the SCAD Program Office. The POMP used a linear responsibility chart (matrix) to relate management positions, functions and responsibility relationships to each other. It pointed out where there was duplication of effort and overlapping responsibility as well as where there were responsibility gaps. (59)

A second unique effort of the Program Control Division was the integration of segment schedule networks into a total program schedule network. The program office received schedule status information on a monthly basis from each of the associate contractors. The information, punched on computer cards, was reformatted as necessary to make it compatible with ASD's Control Data Corporation PERT/TIME computer program. Through identification and common coding of interface events (those common to two or more associate contractor's networks) the individual networks were machine processed as a single network. The resulting program network was both printed out in various sorts and plotted to give upper management a view of the total program. It was the only tool available to management which displayed the logical sequence of activities and constraints necessary for completion of the total effort. In several instances the network integration task led to discoveries of inconsistent and incompatible scheduling among the associate contractors, predicted schedule slippages, and forecast results based on replanning efforts.

Engineering Division. During the conduct of the SCAD effort, ASD engineers participated in several undertakings not performed at Wright-Patterson AFB for the last decade. Their most significant achievement was a complete preliminary design of the SCAD system prior to RFP release. The effort was initiated in November 1971 by 40 engineers from ASD and the laboratories. In five weeks, the team documented over 1000 possible design approaches and 32 separate preliminary designs, including inboard profiles and complete flight envelope performance. These studies identified the required engine thrust and specific fuel consumption and formed the basis for the preliminary engine specifications. Besides the obvious

benefit of doing a preliminary design, the program office also benefited by verifying the specifications which were in the RFP. Many changes were made in the specifications and the statement of work was changed to reflect more effort on the areas of greatest uncertainty. (66)

Strengths and Weaknesses Observed in SCAD's Application of the In-House Approach

The in-house approach was neither totally good nor totally bad for SCAD. Both strengths and weaknesses were observed and reported by personnel associated with the program.

Strengths. The most significant strength of the SCAD program was the total involvement of government personnel in the day-to-day problems of acquiring a complex weapon system. This strength was mentioned by practically all of the persons interviewed, including one industry representative, Mr. J. B. Lewi of Litton who stated: "the program office had better visibility into real problems - they understood the problems in defining interfaces." Segment team members were aware of what was going on in their segment; there were no surprises, no hidden problems. This writer knew of problems which a prime contractor could have kept concealed from the Air Force, but which most segment team members were well aware of. For example, detailed technical problems in the Decoy segment involving high voltage power supplies and traveling wave tubes were surfaced and resolved long before they developed into major system problems. Many other potential problems in the areas of packaging, cooling and secondary power were also aired using the in-house approach in lieu of some other approach requiring less government involvement. Even top management had tremendous visibility and insight into technical and management

problems. There was no blind acceptance of a contractor's word, but a questioning attitude based on a thorough understanding of the problem areas. The concept of direct and total involvement was fostered by the program office and it had positive and long reaching impacts.

One of those impacts which this writer observed was the attraction the program had for certain people. Because the SCAD Program Office was making decisions and initiating action instead of monitoring and evaluating a prime contractor's work, people with initiative and a desire to do something unique and important sought jobs with SCAD. The approach fostered a condition of personal and professional involvement and self confidence. People who came to SCAD with little or no in-house experience were trained on-the-job. Toward the end of the program the office was becoming adept at dispensing with engineering and management problems in an effective manner. The program office was a better motivated and challenged group.

Another strength of the in-house concept exhibited by SCAD was far reaching government influence in system design. The program office with its direct access to AFLC, ATC and SAC personnel was able to make realistic trade-offs based on true Air Force needs. One of the best examples of this capability was the program office decision to delete the requirement for deaerated fuel by increasing the strength of the tank structure. The estimated cost saving was $17.5 million dollars over the program life cycle with only minor impacts on performance. Under a prime contractor arrangement, this and other trades may never have been made, for the contractor initiates trades based on how he perceives the needs of the Air Force with, no doubt, some bias toward his own self interest. The SCAD approach resulted in a design optimized to suit the mission requirements

and not optimized to maximize profits. (66)

Weaknesses. The primary weakness in SCAD's use of the in-house approach as identified by most persons interviewed was that there simply did not exist at ASD the talent in sufficient numbers to accomplish the in-house job effectively. A typical comment came from Mr. S. D. Hawkins, of ASD Engineering when he said: "ASD does not have enough of the right kind of talent." Mr. Singer's survey identified this weakness before the concept was implemented, but the problem was largely ignored. The result was that those people who were involved with SCAD spent many extra hours in the office and traveling to keep up with the huge task of system integration. Several of the people interviewed felt that this lack of qualified people was the primary reason for the program office's initial slowness in decision making. This undoubtedly did slow decisions, but is only one of several reasons such as personalities involved and the organization structure employed which resulted in some slowness in making decisions.

From both personal observation and interviews, many of the people assigned to the program were of little benefit to the system integration effort. SCAD was trying to do something that had not been done at ASD in years and many people suffered from the inertia of their most recent experiences in program management. They were not accustomed to decision making and had become nothing more than checkers and monitors. The consensus of those interviewed was that many ASD engineers lacked expertise, were rusty, and had little confidence in their ability. Their ability was also doubted by some of the contractors who spoke of "Government Service deadheads" and alluded to "weak areas in the program office such as engineering analysis and integration." Mr. P. R. Klender pointed to a possible reason for this weakness in the Air Force:

> "If the defense industries selected or manned their top positions as DoD does, they would be utter failures. The 'Peter Principle' is a way of life for both civilians and military within DoD. Industry, however, is much more active in eliminating dead wood when sales are on the down slope."

Overall, SCAD suffered from not having enough people who were trained to do the system integration job the in-house approach requires.

Another major weakness exhibited by SCAD might be termed "segmentitis." The program was managed by breaking the system into segments and forming teams of specialists to work on each segment as described previously. The result was a series of optimized segments with little effort expended toward an optimized system. The systems approach on which weapon system acquisition is based was lacking. Over concentration on each segment left system integration unattended. The Program Office Management Plan called for system integration to be done primarily by the Projects Division, but did not explain how the job would be done except in segment terms. Finally, after months of doing without, a System Integration Manager was appointed within the Projects Division. Until that time system problems were worried alternately by the Chief of Engineering, the Program Manager and his Deputy, the Airframe/Air Vehicle Segment Manager, the Chief of Projects, and other functional division chiefs at various times.

The organization also exhibited problems inherent in matrix organizations. Segment team members found themselves working for both their functional boss and their segment manager. This dual accountability often resulted in conflict and frustration for both the bosses and the team members. Since the segment manager had no real authority over his team

members, he could only ask for help, with help coming in whatever form the functional divisions saw fit. The functional division chiefs in general out-ranked the segment managers and this too made it difficult for segment managers to operate as mini program managers as had been planned. Segment managers had to resort to persuasion and coercement to get the functional support they needed. As the program progressed there seemed to be more reliance on the functional organization with less emphasis placed on segment teams and the matrix organization. The informal organization was shaping the organizational approach to a more acceptable and workable form.

Strong personalities existed in all key positions in the SCAD Program Office. Because of the strong personalities and a program office organization which invited conflict, there was considerable in-house fighting. Most apparent was the struggle to assert technical direction by both Projects and Engineering. According to the Program Office Management Plan, the Engineering Division was responsible for system engineering and technical direction, but the Projects Division was responsible for systems integration. This situation was the result of poorly defined terms used to describe responsibilities early in the program. The dual and overlapping responsibility resulted in in-fighting and misdirection to contractors. The engineers argued that they would give technical direction and let Projects give cost and schedule direction. The problem is that technical, cost and schedule direction must go hand in hand to result in true system integration. To do in-house management requires close cooperation and definition of roles. SCAD suffered from in-house disagreements.

Another weakness of SCAD's approach was caused by the contractor's

reluctance to give up their previous roles as primes and subcontractors. The Boeing Company was slow to take direction from segment managers and tended to press for their own design. One person interviewed commented specifically on Boeing's refusal to accept the deareated fuel decision for some time, instead designing the fuel tanks based on their own decisions. Other persons interviewed mentioned other cases where Boeing pressed for its own methods and designs to be adopted. The writer is also aware of times when Boeing was asked for and gave program scheduling changes to other associate contractors.

A final weakness of the in-house approach as utilized by SCAD was the complex contractual arrangements. Using associate contractors meant having six major contracts in effect besides the SE/TA contract and Memoranda of Agreement with all external organizations. This complex web of interrelationships was overwhelming. The communications problems, amount of paper work, and slowness of decision making illustrate the problems associated with trying to integrate so many parties into a working team. It was only through the dedicated, hard working team members that the program was progressing on schedule, within cost, and meeting technical performance goals at the time of termination.

V. Conclusions and Recommendations

The management approach to be adopted by a program manager is a key decision which must be made early in the acquisition process. This report has presented one innovative management approach and now offers the following conclusions and recommendations concerning that approach in hopes that they will be of assistance to future program managers.

Conclusions

The in-house approach as exemplified by the SCAD program does have merit and should therefore be considered as a potential management arrangement for use on new systems. The approach causes the Air Force to be in a more responsible position. The program office has better control over the development and can directly influence the design so as to optimize the system. The Air Force becomes the decision maker and activator as opposed to a monitor and evaluator. Energetic people are drawn to such an organization and they benefit from the increased visibility and understanding of development problems. This increased awareness will lead to fewer unanticipated problems.

If the approach is to be used, the program office must be properly manned to do the job. The task is extraordinary and requires extraordinary people. They must be acquainted with the acquisition process and thoroughly understand the in-house concept. They must also be technically and managerically sound, and be willing to commit themselves and the Air Force to decisions. Not only must the program office be manned with qualified people, it must have the right number of such people. Normal program office manning will not suffice. It was estimated by a majority of the people interviewed during the research that to

do the in-house job properly we need to at least double the size of a normal program office.

The SCAD program did suffer from its own internal organization. Too much emphasis was placed on subsystem development and too little on system integration due to the use of segment teams. Segment managers, functional division chiefs and team members found the organizational arrangement to be frustrating and conflict inducing. It should not be used in conjunction with the in-house approach.

Use of the approach requires that all roles be defined explicitly. Each associate contractor must know exactly what his responsibilities are and those of the other organizations involved. The Air Force must make perfectly clear its role and expectations. Participating agencies and service assistance contractors must also be totally cognizant of the responsibilities of themselves and others. Internally, the program office must adequately define its own role and partition the tasks so as to avoid either overlapping responsibility or lack of responsibility for each task.

Recommendations

In order to take full advantage of the strengths of the in-house management approach, yet minimize its weaknesses, the writer makes the following suggestions.

ASD should attempt to expand its present capability to do in-house programs by selectively adopting the approach. The concept in the near future should be applied to relatively simple systems. These non-complex weapon systems should not be state-of-the-art developments nor employ large numbers of subsystems with difficult to define interfaces. By attacking small, uncomplicated, developments initially the approach can

used for major weapon system acquisition. This would also allow ASD to train an adequate number of managers and engineers in the use of the approach. As the number of people exposed to the approach, in both government and industry, grows and the level of experience at ASD increases, larger and more complex systems can be attempted.

In light of the problems SCAD had because of its own internal organization, it is further recommended that the segmented approach with a matrix organization not be utilized. Instead, a more simple organization structure should be applied. Either a pure functional organization or project organization should be used, but not a combination of both. Under the functional approach the program office would resemble the standard program office organization of Figure 1. The system integration task would fall on the program manager and his assistant at the top of the organization. They would be the single point of contact for associate contractor program managers. There would be no Projects Division and no "segmentitis." Under a pure project organization the program office would be made of project offices corresponding to each associate contract. Within each of these project offices one would find specialists in each area normally associated with the divisions. There would be, however, no divisions other than the project offices. Each person would have only one boss, i.e., the project manager. The integration job would again fall to the program manager and his deputy.

The unique and innovative techniques SCAD employed did contribute to the approach and should be considered on future in-house programs. SCAD documents describe the techniques in detail and are available to interested program management officers. One of the most potentially useful innovations was use of Linear Responsibility Charts (LRC). It is

recommended that these be developed early in program's life cycle and updated periodically to reflect current responsibility allocation. It is also recommended that the scope of the LRCs be broadened to include not only the program office but also all participating organizations and associate contractors. This should insure that all parties are fully aware of who is responsible for what tasks.

Finally, it is recommended that additional studies be conducted on all other management approaches conceived. A series of such empirical studies would provide a program manager with a choice of potentially effective approaches which might be taken. He would be aware of the strengths and weaknesses of each approach and be able to avoid the pitfalls experienced by his predecessors. Additional study should also be done on any future applications of the in-house concept. These studies would help refine the approach and further point out unique features which should be included in the future. One particular study is highly recommended. That would be a case study of the Air Launched Cruise Missile (ALCM) program, the redirected SCAD effort. This program, which is just getting started, will use a similar management arrangement and many of the same people as SCAD. While the exact approach to be used is not yet fully defined, a future study which compared the SCAD and ALCM approaches would be interesting and useful in a continuing effort to describe and analyze the in-house approach to weapon system acquisition.

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Appendix A

Form Used to Conduct Focused Interviews

NAME:

DATE, TIME:

INTRODUCTION: The Subsonic Cruise Armed Decoy Program Office utilized a management concept which made maximum use of in-house management and development resources. Using this approach, the Program Office contracted for, managed the development of, and was responsible for the integration of all major subsystems. Multiple contracts were used and an associate contractor structure employed. The Program Office performed as the technical manager for the system engineering and integration functions in lieu of a system or prime contractor. This approach came to be known as the "in-house management approach."

The purpose of this interview is to gather data on this management approach and its use on the Subsonic Cruise Armed Decoy Program.

1. What was your relationship to the SCAD Program? Dates involved? Title?

2. What is your understanding of the term "in-house management?" How would you define the "in-house management approach?" What responsibilities would you give the PO?

3. Are you familiar with use of the in-house approach on programs other than SCAD?

4. What did SCAD do that was different from your definition or what others have done?

5. Do you know how SCAD came to use the approach?

6. What role in the in-house management process did Calspan play?

7. What do you see as potential or interent weaknesses of the in-house management approach?

8. Did SCAD suffer from these inherent weaknesses or others which might have been unique to the SCAD Program Office?

9. What do you see as potential or inherent strengths of the approach?

10. Did SCAD exhibit these inherent strenghts or others which might have been unique to the SCAD Program Office?

11. What can we in the Air Force do using the in-house management approach that cannot be done better by using a prime or system contractor.

12. Would you suggest that the Air Force continue to use this approach? Why or why not?

Appendix B

Persons Interviewed During Research

Mr. J. A. Boykin, Technical Director, ASD Deputy for Systems, Member of SCAD Advisory Group.

Colonel J. R. Brill, SCAD Program Manager, July 1971 - July 1973.

Mr. J. A. Burchett, SCAD Integrated Logistic Support Manager for Airframe/Air Vehicle Segment, Sep 1969 - Jul 1973.

Lt Col L. A. Davila-Aponte, SCAD Deputy Program Manager for Logistics, Sep 1971 - Jul 1973.

Mr. M. B. Dunn, Boeing Program Manager, Airframe/Air Vehicle Segment, Oct 1970 - Mar 1973.

Mr. R. R. Gideon, Lockheed Engineer on SCAD Study Contract, 1968 - 1971, Cornell Aeronautical Laboratory Engineer, 1971 - 1973.

Mr. A. J. Goebel, SCAD Procurement Contracting Officer, Aug 1971 - Apr 1973.

Mr. J. A. Griffin, SCAD Chief Airframe Engineer, Nov 1971 - Jul 1973.

Mr. S. D. Hawkins, Management Operations, ASD Deputy for Engineering Support for SCAD, 1968 - 1973.

Colonel W. W. Hemenway, SCAD Deputy for Projects, Sep 1971 - Aug 1972.

Mr. R. C. Johnston, SRAM Deputy System Program Director, Apr 1965 - present.

Mr. P. R. Klender, SCAD Chief System Engineer, Jul 1968 - Jul 1971, Assistant Chief System Engineer, Jul 1971 - Jul 1973.

Mr. J. B. Lewi, Litton Program Director, Navigation/Guidance Segment, Jul 1972 - Jun 1973.

Captain E. H. Majkowski, SCAD Project Manager, Navigation/Guidance Segment, Aug 1971 - May 1974.

Mr. J. W. Millard, Williams Research Corporation, Dayton Office Manager, Aug 1972 - present.

Mr. R. L. Miller, Boeing, Dayton Representative, Apr 1970 - Aug 1972, Assistant Program Manager, Aug 1972 - Jul 1973.

Colonel G. L. Monahan, SCAD Deputy for Projects, Aug 1972 - Jul 1973.

Colonel M. M. Newkirk, SCAD Deputy for Procurement and Production, Sep 1971 - Jul 1973.

Mr. J. Price, Cornell Aeronautical Laboratory, System Engineer, Aug 1971 - Jul 1973.

Mr. R. M. Sadow, SCAD Plans and Documentation Group, Jul 1971 - Jul 1973.

Mr. J. E. Short, ASD Assistant for Special Projects, Advisor to SCAD Program, Nov 1970 - Apr 1971.

Mr. J. Singer, SCAD Assistant Program Manager, Oct 1968 - May 1972, Program Manager, Nov 1970 - Jul 1971.

Colonel R. T. Smyth, SCAD Assistant Program Manager, Aug 1972 - Jul 1973.

Colonel (Retired) A. L. Wood, SCAD Program Manager, Jul 1969 - Nov 1970.

Lt Col G. E. Wilkinson, SCAD Assistant Test Manager, Aug 1971 - Jan 1973, Deputy for Test and Deployment, Jan 1973 - Jul 1973.

Appendix C

Glossary of Terms Used in Chapter 3

Concept Formulation Package/Technical Development Plan - Document prepared during the Conceptual Phase which addresses the rationale for selecting a preferred system from competing alternatives, defines and develops preliminary cost and schedules for development and acquisition.

Conceptual Phase - The first phase of the weapon system acquisition process. The technical, military and economic bases are established and the management approach is delineated.

Defense System Acquisition Review Council - The formal body of OSD officials who review major programs to ensure that they are ready for transition to the next life cycle phase. They advise the Secretary of Defense on program decisions. Membership is composed of DDR&E, Assistant Secretaries of Defense for Installations and Logistics, Systems Analysis, the Comptroller, and appropriate Service Secretary.

Development Concept Paper - A coordinated management document which serves as the vehicle for major program decisions by the Secretary of Defense. It contains primary program information (reasons for having the program, anticipated cost and schedule, and risks), decision rationale, and decision review thresholds. When approved by the Secretary of Defense, it serves as authority to proceed do the next phase of acquisition.

Full Scale Development Phase - The third phase in the development of a system. During this phase most major components of the entire system are designed, fabricated, tested, and evaluated. The result of this phase is

the hardware and documentation necessary to assure that the program is ready for production.

Initial Operational Capability - The delivery of a specific number of weapon systems needed to equip one unit of the operating command thereby providing the unit system employment capability.

Requirements Action Directive - A document issued by Headquarters USAF which provides the authority, direction and guidance necessary for those actions needed to translate a Required Operational Capability into an approved program for development and production of a new or improved weapon system.

Request for Proposal - A Program Office prepared document issued to interested and capable contractors. It is a statement of what the government is proposing to buy and a solicitation for bids.

Required Operational Capability - A document initiated by an operational command or other interested agency, which cites the need for and requests a new or improved weapon system capability.

System Management Directive - A document issued by Headquarters USAF which provides current guidance in initiating, changing, transitioning, or terminating a program.

Validation Phase - The second phase of system acquisition in which major program characteristics (technical, cost, and schedule) are validated and refined through extensive study and analyses, hardware development, test and evaluation.

PII Redacted

Vita

Robert Wayne Buckner was born on [redacted] After graduating from [redacted] in 1963, he attended Auburn University. In 1967 he received a Bachelor of Science Degree in Aviation Management and was commissioned as a Lieutenant in the USAF. His first assignment was in the Strategic Air Command as a Minuteman Missile Launch Officer. His last military assignment prior to attending the Air Force Institute of Technology was as a System Program Management Officer, Subsonic Cruise Armed Decoy Program Office, Wright-Patterson AFB, Ohio.

PII Redacted

Permanent address: [redacted]

This thesis was typed by Mrs. Valaria J. Buchanan